The American Midland Naturalist

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TERMINOLOGY OF TYPES[1]

DONALD LESLIE FRIZZELL

I. INTRODUCTION

A. PURPOSE OF THE PAPER

Recognition of the value of specimens as types of species and nomenclatural units of lesser rank has led to the proposal of many terms, in the hope that systematists in general would recognize the value of the objects thus indicated, and would appreciate their importance as available elements of well cared-for collections. Specialists dealing with generic nomenclature have introduced, in addition, a series of expressions denoting species that are to be regarded as types of genera. Disregard or ignorance of existing literature has led to the proposal of many terms that are, unfortunately, either homonyms or synonyms of terms already in existence, or that do not conform to the accepted rules of nomenclature. In other instances this disregard has resulted in redefinitions of questionable value.

One does not have to go far afield for examples of lack of uniformity in current type terminology. On the same page of a well-known book one subgenus has a "holotype" and another subgenus a "genoholotype," whereas on another page a subgenus has a "subgenotype." What does "lectotype" mean? In 1905 it meant a "syntype chosen, subsequently to the original description, to take the place which in other cases a holotype occupies." In 1925 it meant a specimen chosen by a later author when no holotype exists. But in 1928 it was proposed—

[1] Read in part before the Paleontological Society, Pacific Coast Branch, April 8, 1933.

in apparent ignorance of prior usage—as a genotype and defined as a "type by subsequent designation." For the term "genotype" alone there are more than thirty synonyms.

In order to forestall any further confusion, a list of nomenclatural type terms has been compiled, with annotations, showing those which may be considered available and those that should be rejected. With these nomenclatural terms are included words compounded with "type" (insofar as they are employed in biology) but which do not denote types in the nomenclatural sense.

B. NATURE OF A NOMENCLATURAL TYPE

There is considerable literature dealing with the type-concept in biology. Since the purpose of this paper is to evaluate the type terms already in existence rather than to treat the question of types in general, a detailed discussion of the nature of a type term is beyond its scope. Reference to the papers listed in the accompanying bibliography is essential to an understanding of the nature of types and the necessity for their use.

A type, in biological nomenclature, has been described as an anchor by which a specific or generic *name* is fixed. It may be a tangible object, as the *type specimen* (or type specimens) of a species, or intangible, as the *type species* of a genus. In either case the type is the final piece of evidence by which a name is evaluated. Moreover, nomenclatural units are distinct from biological units. Every proposed specific *name*, for example, is a nomenclatural *species* and has one or several type *specimens*. Similarly, every adequately defined generic *name* is to be regarded as a nomenclatural *genus* and must have its type *species*. Disposition of these names depends, in the absence of homonymy, upon the biologic elements upon which they are based. Thus, if the type specimens of a number of nomenclatural species fall within the limits of a single biological species (that is, have certain characters in common, occupy the same general ecological position, presumably interbreed, and so on), the specific names are shown to be synonyms and the earliest is given preference. Further, a nomenclatural type is not necessarily "typical" of the biological spe-

cies. An average specimen of a species (a biologically typical form) may differ materially from the specimen that is, through the accident of collection or selection, made the type of the species. Nevertheless, examination of a series of specimens will demonstrate indisputably that the two specimens belong to the same biological unit and must bear the same specific name.

C. CHOICE OF TYPE TERMS

All the terms incorporated in the following list were proposed (some with definition, many without) for use in biology and are, therefore, to be considered by systematists in any field. Which of these terms shall we employ? Should current usage, priority, completeness of definition, or the preference of the individual worker prevail? The present chaotic condition cannot be alleviated unless some logical basis for selection is established. Priority, except where it conflicts radically with usage, is the basis recommended by the writer.

Availability of a term, however, does not imply its recommendation. On the contrary, a limited number of terms is desirable if the goals of uniformity of usage and ease of comprehension are to be attained. Certain groups of organisms, of course, will require types and corresponding terms which would be absurd in other groups. Thus the term "morphotype" for a particular specimen of one generation of a dimorphic foraminifer might be appropriate, or the term "nepionotype" for a selected and designated example of a larval stage of a cephalopod species. On the other hand, any specimen in any collection can be classed as some type or even labelled with a number of type terms. For example, a specimen which any working systematist would regard as a *paratype* might very well be at the same time an *adelfotype*, an *alloparatype*, an *androtype*, a *lipotype*, a *mimotype* and a *paraedocotype*.

Although the judicious use of hyphens would be a great help in conserving space in publications, as well as the time of authors, it could not reduce the fundamental absurdity of such a term as *para-adelfo-allopara-andro-lipo-mimo-paraedocotype*. The information conveyed by this formidable set of terms

(that the specimen was included in the original collection; was used as basis for the original description; that it is of the same sex (male) as the allotype; shows the genitalia; is characteristically absent from certain faunas; and is analogous to certain unrelated forms in other countries) would require little more space in a catalogue or publication than is necessary for the terms themselves. Similarly, many equally absurd terms may be avoided simply by writing on the specimen-label the authority for, and date of, the identification.

D. RECOMMENDATIONS

This paper is presented with the full realization that there will always be two points of view in regard to type terminology. One group of workers will advocate the use of but few terms, whereas another group will feel that a large number of precise terms implies precision of method. Consideration of these views in a symposium on procedure in the description of a new species, recently held in the paleontological division of the Department of Geology at Stanford University, demonstrated the need for a summary of terms such as that presented herein. The consensus of opinion, further, was that the logical course in dealing with nomenclatural types is to reduce the number of terms to the minimum; thus each term becomes genuinely significant and the total bulk is not too great for the average curator or taxonomist. With this idea in mind the writer recommends that the general use of type terms be restricted to *genotype*, *syntype*, *holotype*, *paratype*, *lectotype*, *neotype*, *hypotype*, *topotype*, *homoeotype*, and *plastotype*, as hereafter defined.

E. ACKNOWLEDGMENTS

To Professor M. H. Hatch, of the University of Washington (Seattle), the writer is indebted for pointing out to him the useful paper by Horn,[2] which has aided materially in this compilation. Thanks are due to Miss Helena M. Nye, of the Department of Germanic Languages at Stanford University, for assistance in translation. Professor Siemon W. Muller

[2] See bibliography.

and Professor LeRoy Abrams, of Stanford University, Dr. George S. Myers, of the U. S. National Museum, and Dr. J. Clausen of the Carnegie Laboratory, Stanford University, kindly pointed out terms which would otherwise have escaped the writer's notice. Mr. Edward T. Schenk has given the various terms practical consideration during a cataloguing of the Stanford type collection of fossils. Finally, Professors Hubert G. Schenck and Gordon Ferris, of Stanford University, have offered suggestions for the improvement of the manuscript.

F. SELECTED BIBLIOGRAPHY

Bather, F. A.—A postscript on the terminology of types. *Science*, (n. s.), vol. 5, pp. 843-844, 1897.

Cook, O. F.—The method of types. *Science*, (n. s.), vol. 8, p. 513, 1898.

The method of types in botanical nomenclature. *Science*, (n. s.), vol. 12, p. 475, 1900.

Types and synonyms. *Science*, (n. s.), vol. 15, pp. 646-656, 1902.

Terms relating to generic types. *American Naturalist*, vol. 48, pp. 308-314, 1914.

Holland, W. J.—Forum on problems of taxonomy: Types. *Trans. 4th Inter. Congress of Entomology, Ithaca, August, 1928*, vol. 2, pp. 688-693, (1929).

Horn, W.—Über den musealen Missbrauch mit Insekten— <Typen>. *X^e Congrès International de Zoologie*, Sect. 6—Athropodes, pp. 1022-1042, 1929.

Howell, B. F.—Third report of special committee on marking of type specimens. *Bull. Geol. Soc. Am.*, vol. 40, pp. 215-220, 1929.

Lindholm, W. A.—Vorschläge zur genaueren Bezeichnung der Genotypen. *Zoologischer Anzeiger*, Bd. 63, s. 161-165, 1925.

Eine weitere Kategorie von Genotypen. *Zoologischer Anzeiger*, Bd. 63, s. 245-247, 1925.

On the designation of genotypes. *Nautilus*, vol. 41, pp. 97-98, 1928.

Marsh, O. C.—The value of type specimens and importance of their preservation. *American Journal of Science*, vol. 6, pp. 401-405, 1898.

Merriam, C. H.—Type specimens in natural history. *Science*, (n. s.), vol. 5, pp. 731-732, 1897.

Thomas, O.—Suggestions for the more definite use of the word "type" and its compounds as denoting specimens of a greater or less degree of authenticity. *Proc. Zoological Society*, pp. 241-242, 1893.

Types in natural history and nomenclature of rodents. *Science*, (n. s.), vol. 6, pp. 485-487, 1897.

Schuchert, C.—What is a type in natural history? *Science*, (n. s.), vol. 5, pp. 636-640, 1897.

(and S. S. Buckman)—The nomenclature of types in natural history. *Annals annd Magazine of Natural History*, (ser. 7), vol. 16, pp. 102-104, 1905.

(and S. S. Buckman)—La nomenclature des types d'histoire naturelle. *Archives de Zoologie expérimentale et générale*, vol. 4, pp. 14-16, 1905.

Catalogue of the type and figured specimens of fossils, minerals, rocks, and ores. Pt. I. Fossil Invertebrates. *Bull. U. S. National Museum*, No. 53, pp. 9-18, 1905.

Swingle, W. T.—Types of species in botanical taxonomy. *Science*, (n. s.), vol. 37, p. 864, 1913.

Waterston, J.—Forum on problems of taxonomy: Discussion on types. *Trans. 4th Inter. Congress of Entomology, Ithaca, August, 1928*, vol. 2, pp. 695-699, (1929).

II. ANNOTATED LIST OF TERMS

A. EXPLANATION OF ANNOTATIONS

In the following list, symbols have been employed to indicate the status of the various terms. Terms printed in boldface type are recommended by the writer (for example, **genotype**); large capitals indicate terms which, although not recommended, are available for use (as AEDOEOTYPUS); homonyms are shown in large and small capitals (LECTOTYPE); and synonyms are in italics (as *adelfotype*). If a term is both a homonym and a synonym, it is printed as the former but with its equivalent expression within parentheses. The "equals" sign (=) indicates terms considered by the writer absolutely or partially equivalent. Brackets ([ ]) inclose those terms which seem objectionable or are not nomenclatural. An asterisk (*) preceding a term indicates that the definition and reference are taken directly from Horn,[3] the only change being in translation.

The following definitions, unless otherwise indicated, are the work of the writer and represent either abstracts of original definitions or interpretations of usage. In either case the source is indicated by the appended reference.

[3] See bibliography.

B. LIST OF TERMS

1. **Adelfotype* (= topotype?) — a topotype obtained by the original collector of the species.
   Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 212, 1927.

2. *AEDOEOTYPUS — the first specimen of a species to have the genitalia studied, together with the genital preparation; useful in entomology. *See* holaedoeotypus, paraedoeotypus.
   Toxopeus: *III. Int. Ent. Kongr. Zürich*, Bd. 2, p. 468, 1925 (1926).

3. [*Agriotype] — a wild form which must be considered the ancestor of a domestic form. Not a nomenclatural type.
   Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 213, 1927.

4. **Allohomoiotype* (= homoeotype) — a homoeotype of the same sex as the allo- or lectoallotype.
   Betrem: *Treubia*, vol. 9, Suppl., pp. 3, 246, 1928.

5. **Allolectotype* (= lectoallotype).
   Alexander (briefly).[4] Betrem: *Treubia*, vol. 9, Suppl., pp. 3, 223, 272, 290, 1928.

6. *ALLOPARALECTOTYPE — a specimen from the original material, of another sex than the holotype, and designated later than the original publication of the species.
   Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

7. **Alloparatype* (= paratype) — a paratype of the same sex as the allotype.
   Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

8. **Alloplesiotype* (= hypotype) — a hypotype of the same sex as the allotype.
   Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

9. **Allotopotype* (= allotype + topotype) — an allotype from the same locality as the holotype.
   Alexander: *Ann. Ent. Soc. Amer.*, vol. 12, p. 328, 1919.

[4] The reference is taken from Horn (see bibliography). Alexander apparently was the original proposer of the term.

10. ALLOTYPE I — a paratype of the opposite sex to the holotype. *See* allotopotype, neallotype.

    Banks & Caudell: *Entomological Code,* Washington, p. 15, 1912.

11. *ALLOTYPE II — a specimen of the opposite sex to the holotype and selected by a later worker.

    Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1025, 1929.

12. ALLOTYPE III (= paratype or hypotype) — a specimen chosen by the original author of a species to show morphologic features not exhibited by the holotype. For example, the holotype of a fossil brachiopod might be a dorsal valve, the "allotype" would then be a specimen showing the ventral valve.

    Burling: *Journ. Wash. Acad. Sci.*, vol. 2, p. 519, 1912. Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 219, 1929.

13. ANDROTYPE — a designated specimen of the male sex.

    Banks and Caudell: *Entom. Code, Wash.*, p. 15, 1912.

14. **Anirotype* (= chirotype).

    Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 211, 1927.

14a. [Antetype] (= prototype).

    Webster's New International Dictionary, (Springfield, Mass.) p. 94, 1925.

15. *Apogenotyp* (= genotype) — in case a genus is renamed because of homonymy, its type species automatically becomes the apogenotyp of the renamed genus.

    Lindholm: *Zool. Anzeiger,* Bd. 63, s. 162, 1925.

16. *Apogenotype* (= genotype) — defined as "type fixation through substitution." *See* apogenotyp.

    Lindholm: *Nautilus,* vol. 41, p. 98, 1928.

17. *Apotype* I (= hypotype) — "hypotype" was considered preoccupied and "apotype" proposed as a substitute. As the earlier use of "hypotype" was not in biology, the substitution was not necessary.

    Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905. Banks & Caudell: *Entom. Code,* Wash., p. 15, 1912.

18. APOTYPE II (= genotype) — defined as "type fixation through substitution."
Baker: *Nautilus*, vol. 41, p. 21, 1928.

19. [Archetype] — the ancestral form of any group of organisms. *See* prototype. Not a nomenclatural term.
Darwin: *Origin of Species*, p. 431; also papers of R. Owen.
Swinnerton: *Outlines of Paleontology*, London, p. 270, 1923.

20. [Archetypal] — *See* archetype.
Swinnerton: *Outlines of Paleontology*, London, p. 270, 1923.

21. [*Architype] — a specimen which formed the basis of publication of a species previous to the modern type-interpretation. Unless such a specimen is included in one of the modern categories (in which it will be so termed) it cannot be included with types. *See* arquetype.
Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 214, 1927.

22. [**Arquetype*] (= architype).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1025, 1929.

23. *Associate-type* (= syntype). *See* associierte type.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 11, 1905; *Science*, (n. s.) vol. 5, p. 636, 1897.

24. **Associierte type* (= syntype).— This is a German translation of "associate-type."
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1025, 1929.

25. *Autogenotyp* (= genotype) — type by original designation.
Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

26. *Autogenotype* (= genotype) — *See* autogenotyp.
Lindholm: *Nautilus*, vol. 41, p. 98, 1928.

27. *Autogenotypic* (= isogenotypic).
Cook: *Amer. Nat.*, vol. 48, p. 309, 1914.

28. *Autotype* I (= hypotype) — a specimen illustrated by the author of a species after the date of publication.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905. Banks & Caudell: *Entom. Code*, Wash., p. 15, 1912.

29. AUTOTYPE II (= genotype) — "type by original designation."

Baker: *Nautilus*, vol. 41, p. 21, 1928.

30. *Basic types* (= primary types) — includes holotype, cotype, paratype, lectotype and neotype.

Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 215, 1929.

31. [Biotype] — Individuals of the same "genotypical" constitution constitute a biotype. The term is used in genetics and is in no sense nomenclatural.

W. Johannsen: *Elemente der exakten Erblichkeitslehre*, 1909.

32. [*Biotypus] — "all individuals of a pure line." Not a nomenclatural term.

Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1025, 1929.

33. CHIROTYPE — a specimen upon which an unpublished name *(nomen nudum, chironym)* is based. *See* anirotype, quirotype.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 12, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

34. CHOROTYPE — a fossil specimen collected from the same stratum as the type, *but from a neighboring locality.*

Buckman: *Type Ammonites*, vol. 3, p. 11, 1920.

35. CLASTOTYPE — a part or fragment of the type specimen of a species. Proposed for use in botany.

Swingle: *Journ. Wash. Acad. Sci.*, vol. 2, p. 344, 1912.

36. CLONOTYPE — a specimen taken from a vegetatively propagated part of the individual plant from which the type specimen was obtained. Restricted to use in botany.

Swingle: *Journ. Wash. Acad. Sci.*, vol. 2, p. 345, 1912.

37. COLLATERAL-TYPE — any specimen used in the description of a species, with the exception of the primary types.

Schuchert: *Science*, (n. s.), vol. 5, p. 636, 1897.

38. *Cotype* I (= syntype) — any specimen of the author's original material when no holotype was designated.

Cossmann: *Revue Critique de Paléozoologie*, p. 74, 1904.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 11, 1905.

39. COTYPE II (= paratype) — any specimen of the original type material except the holotype.

See cotype I for references.

40. *Cyrioplesiotype* (= hypotype) — " . . . the principal or typical specimen among several plesiotypes."

Knight: *Journ. Paleo.*, vol. 4, Suppl. 1, p. 27, 1930.

41. [Description-type] — This applies to a description rather than to a specimen and is, in consequence, not a nomenclatural term.

Schuchert & Buckman: *Arch. de Zool. Exper. et Gen.*, vol. 4, p. 15, 1905.

42. *Deuterogenotypic* (= isogenotypic).

Cook: *Am. Nat.*, vol. 48, p. 309, 1914.

43. [Ecotype] — " . . . the ecological unit, to cover the product arising as a result of the genotypical response of an ecospecies to a particular habitat." That is, a form due to selection by environment as opposed to a direct ecologic response. Not a nomenclatural type.

Turesson: *Hereditas*, vol. 3, p. 345, 1922.

44. [Egg type] — *see* locality type.

Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, 1929.

45. [Electotype] (= ?) — undefined; employed, in the case of a species with a poorly preserved holotype, for a specimen from a locality other than the type locality, but which agrees closely with the original description.

Etherington: *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, vol. 20, p. 100, 1931.

46. *Espèce-type* (= genotype) — a literal translation into French of "type species."

Cossmann: *Essais de paléoconchologie comparée*, livr. 3, p. 77, 1899.

47. [Figure-type] — A term applied to the original figure. *See* fototype.

Schuchert & Buckman: *Arch. de Zool. Exper. et Gen.*, vol. 4, p. 15, 1905.

48. [**Fototype*] (= iconotype) — a photograph of a type, rather than a type specimen and, consequently, omitted from nomenclatural consideration.

Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 213, 1927.

49. *Generotyp* (= genotype) — undefined; the type species of a genus.

Rutsch: *Eclogae geol. Helvetiae*, Bd. 24, No. 2, p. 252, 1931.

50. *Genoholotype* I (= genotype) — the single species upon which a genus is based; the species called "the type" by the author of the genus.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

51. [GENOHOLOTYPE II] — used, without definition, for a figure that is regarded as the type of a genus. In the same reference, "genotype" has the conventional meaning. This usage of "genoholotype" conflicts radically with the original definition.

Galloway & Wissler: *Journ. Paleo.*, vol. 1, pp. 50, etc., 1927.

52. *Genolectotype* I (= genotype) — a species chosen from the series of genosyntypes to be the type of a genus.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

53. [*Genolectotype* II]—a selected "genotype." *See* genotype III.

Buckman: *Type Ammonites*, vol. 6, p. 5, 1926.

54. [*Genoplesiotype*] (=plesiotype I) — an undefined term used to replace "plesiotype" in generic usage.

Cossmann: *Essais de paléoconchologie comparée*, livr. 7, p. 147, 1906.

55. GENOSYNTYPE — one of several species from which the type of a genus must be selected.

Schuchert: *Bull. U. S. Nat. Mus., No.* 53, pt. 1, p. 16, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

56. **Genotype** I — "Genotype," as originally proposed, referred to any *specimen* of the type *species* of a genus. Shortly after proposal it became evident that the type of a genus must be a *species* rather than a *specimen*. "Genoholotype" was then proposed for the type species of a genus. It is current practise to use "genotype" for the type species of a genus and some authors complete the reversal by applying "genoholotype" to a specimen. To avoid such confusion the writer here defines "genotype" (according to current usage) as *the single species upon which a genus is based*. "Genoholotype," in its original sense, is considered a synonym of "genotype."

Some workers wish to use other terms for generic types, depending upon how the type species as such, was determined. All that such terms can do, however, is to tell *why* a certain species is adopted — they cannot tell *where* (in what reference) or *when*. This information must always be added. The advantage gained, for example, by writing "orthotype: *X-us albus* Brown 1817, designated by John Doe, 1846" instead of "genotype: *X-us albus* Brown 1817, by subsequent designation (J. Doe, 1846)" is too slight to justify the retention of thirty or more complicated terms.

See apogenotype, apotype, autogenotype, autotype, espèce-type, generotyp, genoholotype, genolectotype, genoplesiotype, genosyntype, genotype auctorum, genotypi falsi, genotypi genuini, haplotype, idiogenotype, lectogenotype, lectotype, logotype, monogenotype, neogenotype, orthotype, paragenotyp, plesiogenotyp, plésiogénotype, pliogenotype, post-type, pseudogenotyp, pseudotype, standard species, subgenotype, tautogenotype, tautotype, type by absolute tautonymy, type by elimination, type by original designation, type by subsequent

designation, type by virtual tautonymy, type species, typus per indicationem, and type per selection.

Schuchert: *Science*, (n. s.), vol. 5, p. 639, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

57. [GENOTYPE II] — the sum total of the genes in an individual. A term in current use in genetics but not apt to be confused with a nomenclatural genotype.

W. Johannsen: Elemente der exakten Erblichkeitslehre, 1909.

58. [GENOTYPE III] — a short expression of "the genotype standard of reference;" a specimen upon which a genus is based, but not necessarily the holotype of the type-species. This usage conflicts with current practise.

Buckman: *Type Ammonites*, vol. 6. p. 5, 1926.

59. GENOTYPE IV (= ?) — the type species of a section.

Etherington: *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, vol. 20, p. 85, 1931.

60. [Genotype auctorum] — undefined, but used to designate a *specimen* upon which a subgenus is erected.

Tegland: *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, vol. 18, p. 280, 1929.

61. [Genotypi falsi] — invalid genotypes. *See* pseudotype.

Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

62. *Genotypi genuini* (= genotypes) — valid genotypes.

Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

63. GRAPHOTYPE — "preoccupied" (*fide* Howell); included here merely for completeness.

Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 216, 1929.

64. GYNETYPE — a designated type specimen of the female sex of a species.

Banks & Caudell: *Entom. Code*, Wash., p. 15, 1912.

65. *Haplotype* (= genotype) — a single species included within a genus at the time of original description.

Cook: *Amer. Nat.*, vol. 48, p. 314, 1914.

66. *Haplotypic* (= monotypic).

Cook: *Amer. Nat.*, vol. 48, p. 311, 1914.

67. *Heautotype* (= hypotype) — proposed to replace "autotype," which was considered preoccupied.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 14, 1905.

68. HETEROTYPICAL — applied to a genus including several generically unrelated species.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

69. **Heterotypisch* (= heterotypical) — a German translation of the English term.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1027, 1929.

70. **Hipotype* (= hypotype).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1027, 1929.

71. **Holaedoeotypus* (= holotype + aedoeotypus) — an aedoeotypus, the preparation being made from the holotype of the species.
Toxopeus: *III. Int. Ent. Kongr. Zürich*, Bd. 2, s. 468, 1925 (1926).

72. **Holohomoiotype* (= homoeotype) — a homoeotype of the same sex as the holo- or lectotype.
Betrem: *Treubia*, vol. 9, Suppl. p. 3, 1928.

73. **Hololectotype* (= lectotype I).
Alexander: (briefly).[5] Betrem: *Treubia*, vol. 9, Suppl. pp. 3, 1928.

74. *HOLOPARALECTOTYPE — a specimen from the original material, later established as a paratype, that belongs to the sex described by the author.
Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

75. **Holoparatype* (= paratype) — a paratype of the same sex as the holotype.
Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

76. *Holoplastotype* (= plastotype) — undefined, but inferred from the reference to be the cast of a holotype.
Grabau: *Principles of Stratigraphy*, p. 919, 1913.

[5] Reference from Horn (See bibliography). Alexander originally proposed the term.

77. **Holoplesiotype* (= hypotype) — a hypotype of the same sex as the holotype.
Betrem: *Treubia*, vol. 9, Suppl., p. 3, 1928.

78. **Holotype** I — a single *specimen* (or fragment) upon which a *species* is based. *See* holaedoeotypus.
Schuchert: *Science*, (n. s.) vol. 5, p. 637, 1897; *Bull U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 10, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

79. HOLOTYPE II (= genotype) — undefined, but used to indicate the type *species* of a subgenus.
Vaughan *in* Cushman: *Cushman Lab. Foram. Research*, sp. publ. No. 1, pp. 351, 352, 1928.

80. HOLOTYPE III (= paratype) — an unfortunate use of holotype due either to a typographical error or to a complete misunderstanding of the term.
McGinty: *Nautilus*, vol. 46, p. 65, 1932.

81. *Homeotype* (=homoeotype).
Banks & Caudell: *Entom. Code*, Wash., p. 15, 1912.

82. **Homoeotype** — a specimen compared by a competent observer with the holotype, lectotype, or other primary type of a species. "Homoeotype" was proposed to replace "homotype," which is preoccupied in biology. *See* allohomoiotype, holohomoiotype, homeotype, homotopotype, homotype, icotype, metatype, and tophomeotype.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 14, 15, 1905.

83. **Homotopotype* (= topotype + homoeotype) — a specimen from the original locality of a species, but not identified by the original author of a species. *See* tophomeotype.
Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 212, 1927.

84. [Homotype I] — that which is constructed on the same plan or type, as metameres of the body. Not a nomenclatural term.
Century Dictionary, vol. 4, p. 2871, 1895.

85. HOMOTYPE II (= homoeotype).
Walsingham & Durrant: *"Merton Rules,"* London, p. 13, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 14, 1905.

86. [Host type] — *see* locality type.
Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

87. *Hypoplastotype* (= plastotype) — an artificial reproduction of a supplementary type.
Schuchert: *Science*, (n. s.), vol. 5, p. 639, 1897.

88. **Hypotype** — a described or figured specimen, used in publication in extending or correcting the knowledge of a previously defined species. "Plesiotype" is discarded because it is both a synonym and a homonym. *See* allopesiotype, allotype, apotype, autotype, cyrioplesiotype, heautotype, hipotype, holoplesiotype, morphotype, neoparatype, plesiotype, secundäre Typen, Supplementär-type, supplementary type.
Schuchert: *Science*, (n. s.), vol. 5, p. 637, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 12, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

89. [*Iconotype] — a drawing or photograph of a type. *See* fototype.
Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 213, 1927.

90. *Icoplastotype* (= plastotype) — undefined; the text implies that this is a cast of an icotype.
Grabau: *Principles of Stratigraphy*, p. 919, 1913.

91. *Icotype* (= topotype + homoeotype + ideotype) — a specimen not necessarily used in literature but nevertheless serving a purpose in identification.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 14, 1905.

92. IDEOTYPE — a specimen examined by the nomenclator himself, but not a topotype. *See* icotype and idiotype.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 15, 1905. Handlirsch: Schröder's *Handbuch der Entomologie*, Bd. 3, s. 89, 1925.

93. *Idiogenotyp* (= genotype) — type by first valid subsequent designation.
Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

94. *Idiogenotype* (= genotype) — *see* idiogenotyp.
Lindholm: *Nautilus*, vol. 41, p. 98, 1928.

95. *Idiotype* (= ideotype).
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

96. **Isocotype* (=topotype?).
Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 212, 1927.

97. ISOGENOTYPIC — applied to all genera based on the same genotype.
Viereck: *Bull. U. S. Nat. Mus.*, No. 83, p. 2, 1914. Cook: *Amer. Nat.*, vol. 48, p. 309, 1914.

98. [Isotype] — one of two or more forms common to different countries. A geographical rather than a nomenclatural type.
Gill: *Ann. Rept. Board Regents Smiths. for 1881*, p. 460, (1883). Schuchert: *Bull. U. S. Nat. Mus.*, vol. 53, pt. 1, p. 16, 1905.

99. ISOTYPICAL — applied to genera based on several congeneric species.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

100. **Isotypisch* (= isotypical).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1030, 1929.

101. [*Larval type*] (= nepionotype) — *see* locality type.
Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, Aug. 1928*, vol. 2, p. 696, 1929).

102. LECTOALLOTYPE I — a specimen from the original material designated later than the original example, and of the opposite sex to that of the lectotype. *See* allolectotype.
Curran: *Canad. Entom.*, vol. 58, p. 311, 1926.

103. LECTOALLOTYPE II — a selected "allotype"; *see* allotype III.
Burling: *Journ. Wash. Acad. Sci.*, vol. 2, p. 519, 1912.

104. *Lectogenotype* I (= genotype).
Bather *in* Buckman: *Type Ammonites*, vol. 6, p. 5, 1926.

105. [Lectogenotype II] — a selected "genotype"; *see* genotype III.
Buckman: *Type Ammonites*, vol. 6, p. 5, 1926.

106. *Lectoholotype* (= lectotype).
Curran: *Canad. Entom.*, vol. 58, p. 311, 1926.

107. **Lectoparatype* (= paralectotype).
Betrem: *Treubia*, vol. 9, Suppl., pp. 3, 127, 142, 1928.

108. **Lectotype** I — a syntype chosen, subsequently to the original description, to take the place which in other cases a holotype occupies. *See* hololectotype, lectoholotype.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 12, 1905.

109. *LECTOTYPE II — a specimen chosen by a later author when no holotype exists.
Handlirsch: Schröder's *Handbuch der Entomologie*, Bd. 3, s. 89, 1925.

110. LECTOTYPE III (=genotype) — type by subsequent designation.
Baker: *Nautilus*, vol. 41, p. 21, 1928.

111. [*Lipotype] — a form, the absence of which is characteristic of a fauna. Not a nomenclatural term.
Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 213, 1927.

112. [Locality type] — one of a series of expressions proposed to illustrate type terms reduced to absurdity. *See* seasonal type, sexual type, larval type, pupal type, egg type, host type, and mimetic phase type.
Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

113. *Logotype* (= genotype) — type by subsequent designation.
Cook: *Amer. Nat.*, vol. 48, p. 314, 1914.

114. *Logotypic* — refers to genera with types by subsequent designation. *See* logotype.

Cook: *Am. Nat.*, vol. 48, p. 311, 1914.

115. MEROTYPE — a part of an organism that furnished the type specimen of a new species; only applicable in the case of perennial plants or vegetatively propagated lower animals.

Swingle: *Journ. Wash. Acad. Sci.*, vol. 2, p. 212, 1912.

116. *Metatype* I (= topotype) — a topotype determined by the original author subsequent to publication of the species.

Thomas: *Proc. Zool. Soc.*, London, p. 242, 1893. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 14, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

117. METATYPE II (= homoeotype) — a specimen compared by the author of a species with the holotype subsequent to publication.

Walsingham & Durrant: *"Merton Rules,"* London, p. 13, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

118. [Mimetic phase type] — *see* locality type.

Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

119. [Mimotype] — one of two or more analogous forms (similar forms representing each other in different areas). Not a nomenclatural term.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

120. *Monobasic* (= monotypical) — refers to a genus with a single included species at the time of publication.

Cook: *Amer. Nat.*, vol. 48, p. 311, 1914.

121. *Monogenotyp* (= genotype) — the single species included in a monotypical genus at time of publication.

Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

122. *Monogenotype* (= genotype) — defined as a "type by original fixation." *See* monogenotyp.

Lindholm: *Nautilus*, vol. 41, p. 98, 1928.

123. MONOTYPE I — the holotype of a species which was described from a single specimen.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

124. MONOTYPE II (= genotype) — defined as a "type by original fixation."
Baker: *Nautilus*, vol. 41, p. 21, 1928.

125. MONOTYPE III (= genotype) — the type of a monotypical genus.
Whitley: *Australian Zoologist*, vol. 7, pt. 3, p. 260, 1932.

126. *Monotypic* — *see* monotypical.

127. MONOTYPICAL — applied to a genus including only a single species at the time of publication.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 16, 1905.

128. **Monotypisch* (= monotypical).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1031, 1929.

129. MONOTYPY — refers to monotypical genera; *see* monotypical.
Grant & Gale: *Mem. San Diego Soc. Nat. Hist.*, vol. 1, p. 502, etc., 1931.

130. MORPHOTYPE I — the type specimen of a different form of a dimorphic or polymorphic species.
Banks & Caudell: *Entom. Code*, Wash., p. 15, 1912.

131. MORPHOTYPE II (= hypotype) — a figured specimen not adding to knowledge of the morphology of a species.
Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 219, 1929.

132. **Neallotype* (= allotype?).
J. H. Durrant, Joicey & Talbot: *Bull. Hill Museum*, vol. 1, p. 7, 1921.

133. *NEANOTYPE — type of the pupa (in entomology).
Alexander: *Cornell Univ.*, Mem. 38, p. 743, 1920.

134. [Necrotype] — a form extinct in a locality. Not a nomenclatural term.
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 17, 1905.

135. *Neocotype* (= neotype) — a new syntype, selected by a subsequent author, in the event of loss of the original type material.

Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 219, 1929.

136. [Neogenotype] — a new genotype chosen because the original genotype is to be considered unrecognizable. This practice is contrary to the International Rules of Zoological Nomenclature.

Cossmann: *Ann. d. Paleont.*, t. 7, p. 6, 1912. Marwick: *Rec. Cant. Mus.*, vol. 3, p. 506, 1932.

137. *Neoholotype* (= neotype) — a new holotype selected by a subsequent worker in the event of loss of the original type material.

Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 219, 1929.

138. *Neoparatype* (= hypotype) — a figured specimen used in addition to a type in redefinition of a species whose original types have been lost.

Plummer & Howell: *Bull. Geol. Soc. Am.*, vol. 43, p. 266, 1932.

139. *Neosyntype* (= neotype) — undefined, but presumably a new syntype selected by a later worker in the absence of any original type material.

Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 218, 1929.

140. [*Neotype* I] (= genotype) — type by subsequent designation or elimination.

Cossmann: *Essais de Paléoconchologie comparée*, livr. 2, p. 2, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 13, 1905.

141. **Neotype** II—a later selected type of a species necessitated by loss of the original type material; the neotype must come from the original locality. Although "neotype" is preoccupied its usage seems so well understood that less confusion would result from the continuation of the term than from its rejection. *See* neocotype, neoholotype, and neosyntype.

Cossmann: *Essais de paléoconchologie comparée*, livr. 2, p. 2, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 13, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

142. NEPIONOTYPE — type of the larva of a species.
Alexander: *Cornell Univ., Mem.* 38, p. 743, 1920.

143. ONOMATYPE — a specimen cited in print but not adding to knowledge of the morphology of the species.
Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 219, 1929.

144. [Oötype] — a genital organ in certain tapeworms. Not a nomenclatural term.
Shull, Larue and Ruthven: *Principles of Animal Biology*, (New York), p. 130, 1920.

145. *Orthotype* (= genotype) — type by original designation.
Cook: *Amer. Nat.*, vol. 48, p. 314, 1914.

146. *Orthotypic* — refers to genera with types by original designation. *See* orthotype.
Cook: *Amer. Nat.*, vol. 48, p. 310, 1914.

147. **Paraallotype* (= paratype) — *see* alloparatype.
Betrem: *Treubia*, vol. 9, Suppl., pp. 3, 208, 1928.

148. **Paraedoeotypus* (= paratype + aedoeotypus) — an aedoeotypus with the preparation made from a paratype.
Toxopeus: *III. Int. Ent. Kongr. Zürich*, Bd. 2, s. 468, 1925 (1926).

149. [Paragenotyp] — a genotype of later designation than that of the first reviser. *See* pseudotype.
Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

150. *PARALECTOTYPE — a specimen from the original material designated subsequently as a paratype; *see* lectoparatype.
Alexander: (briefly).[6] Betrem: *Treubia*, vol. 9, Suppl., pp. 3, 113, 1928.

151. **Paratopotype* (= paratype + topotype) — a paratype from the same locality as the holotype.
Alexander: *Proc. Acad. Nat. Sci. Phila.*, p. 496, 1916.

[6] Reference from Horn (See bibliography and footnote 4).

152. **Paratype** I — a specimen, other than the holotype, upon which an original specific description is based. *See* alloparatype, allotype, cotype, holoparatype, holotype, paraallotype, paraedoeotypus, paratopotype, syntype II.

Cossmann: *Revue Critique de Paléozoologie*, p. 74, 1904. Schuchert: Science, (n. s.), vol. 5, p. 639, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 11, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

153. [PARATYPE II] — in bacteriological usage, a form possessing the sum of the characters of the normal form but differing in one or more respects. No reference is available and the term is included here only for completeness.

154. *Paratype allotype* (= paratype) — a paratype from a different locality than the holotype.

Silvestri: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, p. 693, (1929).

155. *Paratype omotype* (= paratype) — a paratype from the same locality as the holotype.

Silvestri: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, p. 693, (1929).

156. *[Phaenotype] — a summation of the characters of an individual. Not a nomenclatural term.

Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1033, 1929.

157. [*Phaenotypus*] — *see* phaenotype.

158. [Phase type] — a type specimen exhibiting a "phase" different from that of the holotype. That is, a specimen of another sex, age, dimorphic form, ecologic response, and so on.

Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

159. [*Phenotype*] — *see* phaenotype.

160. [*Photographotype*] (= phototype).

Kellerman: *Journ. Wash. Acad. Sci.*, vol. 2, p. 347, 1912.

161. [Phototype] — a photograph of a type specimen. *See* fototype.

Kellerman: *Journ. Wash. Acad. Sci.*, vol. 2, p. 347, 1912.

162. [Piesmotype] — a picture printed from a plate bearing an imprint made by mechanical means from an authentic merotype. Proposed for use in botany.

Swingle: *Science*, (n. s.), vol. 37, p. 866, 1913.

163. *Plastocotype* (= plastotype) — *see* plastoholotype.

Burling: *Journ. Wash. Acad. Sci.*, vol. 2, p. 519, 1912.

164. *Plastoholotype* (= plastotype) — the terms "*plastoholotype, plastocotype, plastoparatype*, etc., meaning respectively any artificial specimen moulded directly from a holotype, a cotype, a paratype, etc." were proposed for paleontologic use. If the "etc." were taken seriously, it would be possible to duplicate the entire number of previously proposed types by addition of the prefix "plasto-" to each.

Burling: *Journ. Wash. Acad. Sci.*, vol. 2, p. 519, 1912.

165. *Plastoparatype* (= plastotype) — *see* plastoholotype.

Burling: *Journ. Wash. Acad. Sci.*, vol. 2, p. 519, 1912.

166. **Plastotype** — any artificial specimen moulded directly from a type. *See* holoplastotype, hypoplastotype, icoplastotype, plastocotype, plastoholotype, plastoparatype, and protoplastotype.

Schuchert: *Science*, (n. s.), vol. 5, p. 639, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 15, 1905.

167. [PLESIOGENOTYP] — any species which, at the time of the description of a genus, was only questionably or conditionally referred to the genus, and which has been since designated as the type. *See* pseudotype.

Lindholm: *Zool. Anzeiger*, Bd. 63, s. 162, 1925.

168. [*Plésiogénotype*] (= plesiotype I).

Cossmann: *Essais de paléoconchologie comparée*, livr. 9, p. 6, 1912.

169. [Plesiotype I] — a species related to the genotype (belonging to the same genus, subgenus and section) but occupying a different geologic formation or zoologic province. *See* genoplesiotype, and plésiogénotype.
Cossmann: *Essais de paléoconchologie comparée*, livr. 2, p. 2, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 12, 1905.

170. PLESIOTYPE II (= hypotype + homoeotype) — a figured or described specimen which has been compared with the type specimen or original figure.
Cossmann: *Essais de paléoconchologie comparée*, livr. 2, p. 2, 1896. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 12, 1905.

171. PLESIOTYPE III — a specimen identified by a later author.
Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

172. *Pliogenotyp* (= genotype) — the type of a generic name which is a synonym of an earlier generic name.
Lindholm: *Zool. Anzeiger*, Bd. 64, s. 246, 1925.

173. [*Post-type*] (= neotype I + neotype II) — apparently this term was proposed at an early date but was definitely rejected in favor of neotype.
Cossmann: *Essais de paléoconchologie comparée*, livr. 2, p. 2, 1896.

174. **Primär-type* (= primary type).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1033, 1929.

175. PRIMARY TYPE — a specimen upon which the description of a new species is based, wholly or in part. *See* basic types, primär-type, and proterotype.
Schuchert: *Science*, (n. s.), vol. 5, p. 637, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 9, 1905.

176. *Proterotype* (= primary type).
Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, p. 9, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

177. *Protoplastotype* (= plastotype) — undefined, but, by inference, a cast of a proterotype.
Grabau: *Principles of Stratigraphy*, p. 919, 1913.

178. [*Prototyp I] — the most primitive representative of a group. *See* archetype.

Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1034, 1929.

179. *PROTOTYP II (= primary type).

Handlirsch: Schröder's *Handbuch der Entomologie*, Bd. 3, s. 89, 1925.

180. [Prototype] — *See* prototyp.

181. [Protype] — a specimen which, because of its completeness supplants a fragmentary holotype. The proposer recommends that the protype of a species be given a subspecific name different from that of the holotype. The term does not conform to any recognized systematic procedure.

Troxell: *Journ. Geol.*, vol. 29, p. 476, 1921.

182. [*Proxy types*] (= protypes).

Troxell: *Journ. Geol.*, vol. 29, p. 479, 1921.

183. [Pseudogenotyp] — any species absent from an originally described genus and later designated as type of the genus. *See* pseudotype.

Lindholm: *Zool. Anzeiger*, Bd. 63, s. 163, 1925.

184. [Pseudotype] — an invalid genotype; as such it has no place in nomenclature.

Cook: *Amer. Nat.*, vol. 48, p. 314, 1914.

185. [Pseudotypic] — refers to a genus with an invalid type; *see* pseudotype.

Cook: *Amer. Nat.*, vol. 48, p. 312, 1914.

186. [*Pupal type*] (= neanotype) — *see* locality type.

Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

187. **Quirotype* (= chirotype).

Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 211, 1927.

188. [Seasonal type] — *see* locality type.

Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1928).

189. **Secundäre Typen* (= hypotypes).
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1034, 1929

190. [*Sexual type*] (= allotype + androtype + gynetype) — *see* locality type.
Waterston: *Trans. 4th Inter. Congr. Entom., Ithaca, August 1928*, vol. 2, p. 696, (1929).

191. SPERMOTYPE — a specimen taken from a representative plant grown from seed of a type plant. A botanical term.
Swingle: *Journ. Wash. Acad. Sci.*, vol. 2, p. 345, 1912.

192. *Standard species* (= genotype) — practically a genotype by subsequent designation. Proposed for botanical usage.
Sprague: *Bull. Misc. Information, Kew Botanic Gardens*, p. 96, 1926.

193. *Subgenotype* (= genotype) — undefined, but, from the connotation, the type species of a subgenus.
Cushman: *Cushman Lab. Foram. Research*, sp. publ., No. 1, p. 134, 1928.

194. [Substitute types] — species arbitrarily taken as types of genera in the case of any "exceptions to rules for generic types."
Hitchcock: *Journ. of Botany* (London), vol. 60, p. 112, 1922.

194a. [Sub-type] (=subphylum). Not a nomenclatural term.
Grabau: *Bull. Buffalo Soc. Nat. Hist.*, vol. 6, p. 118, 1898-99.

195. **Supplementär-type* (= hypotype). *See* supplementary type.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1034, 1929.

196. *Supplementary type* (= hypotype) — a described or figured specimen used in publication in extending or correcting the knowledge of a previously defined species.
Schuchert: *Science*, (n. s.), vol. 5, p. 637, 1897; *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 12, 1905.

197. **Syntype I** — any specimen of the author's original material when no holotype was designated; or any of a series of specimens described as "cotypes" of equal rank. *See* associate-type, cotype.

Bather: *Natural Science*, vol. 4, p. 57, 1894. Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 11, 1905. Schuchert and Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 103, 1905.

198. *Syntype* II (= paratype) — a specimen, other than the holotype of a species, upon which the original description is based.

Lupher & Packard: *Univ. Oregon Publ.*, vol. 1, p. 204, 1930.

199. *Tautogenotype* (= genotype) — *see* monogenotype.

Lindholm: *Nautilus*, vol. 41, p. 98, 1928.

200. [Tautotype I] — " . . . a name of a genus identical with the specific name of one of its components." Although Jordan defined tautotype as a *name* rather than a *type species*, it is obvious from the text of the publication that his intention was to apply the term to the type species. *See* tautotype II.

Jordan: *Genera of Fishes* (Stanford Univ. Publ.), pt. 2, p. 165, 1919.

201. TAUTOTYPE II (= genotype) — the type species of a genus when chosen because of absolute tautonymy.

Jordan: *Genera of Fishes* (Stanford Univ. Publ.), pt. 2, p. 180, 1919.

202. TAUTOTYPE III (= genotype) — type by original designation.

Baker: *Nautilus*, vol. 41, p. 21, 1928.

203. [*Teratotype] — the type of an abnormality or monstrosity. Since a monstrosity is a chance occurrence and certainly not a taxonomic unit, there is no justification for such a type term.

Dallas: *Rev. Chil. Nat. Hist.*, vol. 31, p. 214, 1927.

204. *Tophomeotype* (= topotype + homoeotype) — a specimen from the original locality identified by an authority. *See* homotopotype.

Howell: *Bull. Geol. Soc. Am.*, vol. 41, p. 199, 1930.

205. **Topotype** — a specimen from the original locality from which a species was described. Topotypes are of great

importance as they are often the only clues to the identity of a "lost" or doubtful species. *See* adelfotype, allotopotype, homotopotype, isocotype, metatype, paratopotype, tophomeotype.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 13, 14, 1905. Schuchert & Buckman: *Ann. Mag. Nat. Hist.*, (ser. 7), vol. 16, p. 104, 1905.

206. *TYPE I — in a narrow sense, the holotype of a species (or genotype of a genus).

Horn: *Xe Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

207. *TYPE II — in the older sense, any of the original type material.

Horn: *Xe Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

208. *TYPE III — in a general sense, for any kind of "type."

Horn: *Xe Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

209. [TYPE IV] — in bacteriological procedure, at least one genus is divided into "types," based upon serological homogeneity, instead of species (as *Pneumococcus* type i, ii, iii or iv). No reference is available and the term is included here only for completeness.

209a. [TYPE V] (= phylum). Not a nomenclatural term.

Grabau: *Bull. Buffalo Soc. Nat. Hist.*, vol. 6, p. 118, 1898-99.

210. *Type by absolute tautonymy* (= genotype).

Int. Rules Zool. Nomen., Art. 30, I, d *(Proc. Biol. Soc. Wash.*, vol. 39, p. 83, 1926).

211. *Type by elimination* (= genotype).

Int. Rules Zool. Nomen., Art. 30, III, k *(Proc. Biol. Soc. Wash.*, vol. 39, p. 84, 1926).

212. *Type by original designation* (= genotype).

Int. Rules Zool. Nomen., Art. 30, I *(Proc. Biol. Soc. Wash.*, vol. 39, p. 83, 1926).

213. *Type by subsequent designation* (= genotype).

Int. Rules Zool. Nomen., Art. 30, II, g *(Proc. Biol. Soc. Wash.*, vol. 39, p. 84, 1926).

214. *Type by virtual tautonymy* (= genotype).

Int. Rules Zool. Nomen., Art. 30, III, i *(Proc. Biol. Soc. Wash.*, vol. 39, p. 84, 1926).

214a. [Type-fossils] (= index fossils). Not a nomenclatural term.

Geikie: *Structural and field geology*, (4th ed.), New York, p. 104, 1920.

215. [Type genus]—the generic name from which a family or subfamily name is formed. At present type fixation does not extend to types of families.

Webster's New International Dictionary, (Springfield, Mass.), p. 2224, 1929.

216. TYPE MATERIAL — all original material used in the description of a species, as well as all material used to supplement the description.

Schuchert: *Science*, (n. s.), vol. 5, p. 637, 1897.

217. **Type per selection* (= genotype).

Dallas: *Rev. Chil. Hist. Nat.*, vol. 31, p. 213, 1927.

218. *Type species* (= genotype).

Stewart: *Acad. Nat. Sci. Phila.*, sp. publ. No. 3, p. 37, etc., 1930.

219. [Typembryo] — an embryonic stage. Not a nomenclatural term.

Beecher: *Studies in Evolution*, p. 247, 1901.

220. **Typen-material* (= type material).

Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

221. [Typical] — referring to a specimen with characters corresponding to those of the type material. Although useful, the term is not nomenclatural in nature.

Schuchert: *Bull. U. S. Nat. Mus.*, No. 53, pt. 1, pp. 9, 14, 1905.

222. [**Typisch*] (= typical).

Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1036, 1929.

223. [Typonym I] — originally defined as: "A name based upon indication of a type species, or of a type specimen." Not a nomenclatural term.

Coues: *Auk*, vol. 1, p. 321, 1884.

229. [TYPONYM II] — a generic name based upon a species which has already been used as the type of a genus.
Cook: *Science*, (n. s.), vol. 15, p. 651, 1902.

225. [TYPONYM III] — a name which is rejected "when there is an older valid name based on the same type. . . ." In botanical usage.
Hitchcock: *Science*, (n. s.), vol. 53, p. 314, 1921.

226. **Typus per designationem originalem* (= genotype). *See* type by original designation.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

227. **Typus per designationem subsequentem* (= genotype). *See* type by subsequent designation.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

228. **Typus per eliminationem* (= genotype) — *see* type by elimination.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1036, 1929.

229. **Typus per indicationem* (= genotype) — automatically fixed by the use of the specific name *"typicus"* or *"typus"* at the time of generic proposal.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

230. **Typus per tautoniam absolutam* (= genotype) — *see* type by virtual tautonymy.
Horn: *X^e Congrès Inter. d. Zool.*, sect. 6, p. 1035, 1929.

232. [*Unessential published types*] (= hypotypes).
Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 215, 1929.

233. [*Unessential unpublished types*] (= topotype + homoeotype + ideotype).
Howell: *Bull. Geol. Soc. Am.*, vol. 40, p. 215, 1929.

DEPARTMENT OF GEOLOGY,
LELAND STANFORD JUNIOR UNIVERSITY

A CONTRIBUTION TO THE HERPETOLOGY OF KENTUCKY

CHARLES E. BURT

During the summer of 1932, I was permitted to collect amphibians and reptiles in Kentucky and adjacent areas under a grant secured through the kindness of Dr. Alexander Wetmore, Director of the United States National Museum. The observations made and the materials gathered, together with the previous series in the National Collection which was made available to me through the courtesy of Dr. L. Stejneger and Dr. Doris M. Cochran, serve as the essential basis of the following report. In addition to this, Mr. William M. Clay, a graduate student at the University of Michigan, has generously allowed me to study his private collection of Kentucky amphibians and reptiles, from which a number of valuable records and notes have been taken.

Except in the case of the specimens collected by Mr. Clay, the museum numbers in the present report refer exclusively to examples in the collection of the United States National Museum.

I am grateful to Dr. Frank N. Blanchard for the identification of certain snakes that were referred to him, especially *Natrix*.

LIST OF SPECIES

SALAMANDERS

Triturus viridescens viridescens (Rafinesque)

In CLINTON COUNTY, newts were taken with a dip net from algae mats in a pond at the edge of the woods 6 miles northeast of Albany on June 20, 1932 (Nos. 87618-46). Other records are as follows: Mammoth Cave, EDMONSON COUNTY (No. 25308, R. E. Call); and ESTILL COUNTY (Nos. 57303-304, J. Hurter, 1904).

Ambystoma maculatum (Shaw)

A medium-sized spotted salamander (No. 88047) was secured 4 miles northwest of Albany, in CUMBERLAND COUNTY, on July 25, 1932. It was hiding in a rotted log in a deeply wooded area.

Ambystoma tigrinum (Green)

The tiger salamander has been taken at Russellville, LOGAN COUNTY, by George Bibb (No. 3993).

Plethodon dorsalis (Cope)

These little salamanders have been collected at Mammoth Cave, EDMONSON COUNTY (Nos. 25310-11, R. E. Call); and at Louisville, JEFFERSON COUNTY (Nos. 2776). The latter number is given to the four co-types of the species, which show the dorsal color pattern of the red phase of the form in an excellent manner.

Plethodon glutinosus (Green)

This spotted slimy salamander occurs in moist rotted wood or in damp places under the loose bark of fallen trees and logs. It appears that the main slime-secreting glands are located in the tail, which often becomes milky white in freshly preserved specimens as the salamander glue solidifies in formalin. This same substance may attach to the fingers so closely when the salamanders are handled that it can scarcely be removed without the loss of a portion of the collector's epidermis. In such cases the addition of dirt to the glue at the time of its deposition naturally makes the hands very unsightly.

These slimy salamanders have been found as follows:

Number	County	Locality	Collector	Date
88018–26	CUMBERLAND	4 mi. N.W. Albany	C. E. Burt	7-25-1932
79422–33	EDMONSON	Mammoth Cave	L. Giovannoli	6-1929
57078–79	MORGAN		J. Hurter	1899
88017	WHITLEY	6 mi. S.W. Corbin	C. E. Burt	7-14-1932

Gyrinophilus porphyriticus duryi (Weller)

The type specimen of this species (No. 84300) was col-

lected at an underground waterfall in the Cascade Caverns, CARTER COUNTY, by R. Dury and W. H. Weller on April 6, 1930. The canthus rostralis is marked much less distinctly than in *danielsi*, so it does not show a contrasted black line below the white canthal stripe.

Gyrinophilus porphyriticus porphyriticus (Green)

This salamander was taken in ESTILL COUNTY by J. Hurter in 1904 (No. 57257).

Pseudotriton ruber ruber (Sonnini)

The Hurter Collection contains two red salamanders from MORGAN COUNTY (Nos. 57180-81, 1899).

Eurycea longicauda (Green)

Number	County	Locality	Collector	Date
79438	EDMONSON	Mammoth Cave	L. Giovannoli	9-1929
57192	MORGAN		J. Hurter	1902
104	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	9-9-1932

Eurycea lucifuga Rafinesque

The Powell County exaxmple of this salamander listed below has a large crimson spot on the occiput, which is outlined with flecks.

Number	County	Locality	Collector	Date
79434–37	EDMONSON	Mammoth Cave	L. Giovannoli	1929
57108	MORGAN		J. Hurter	1899
101	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	9-9-1932
96	POWELL	Natural Bridge State Park near Red River	W. M. Clay	8-7-1932

Desmognathus fuscus fuscus (Rafinesque)

Adults of this form were found guarding sets of from 18 to 20 eggs in Metcalfe County on July 25, and in Rockcastle County on July 13. In both cases small trickles of water from the mountainsides were flowing down roadcuts. Here the salamanders and their eggs were located both in masses of moss and in pockets in the underlying gravel and shale.

The common dusky salamander is very generally distributed, occurring in favorable situations both about clear rap-

idly flowing mountain brooks and about the relatively dirty and more sluggish streamlets of the foothills. Where there is water seepage, it may be found in moss, under rocks, under shale, in moist earth, in rotted logs, under loose bark, or under leaves. Specimens have been taken as follows:

Number	County	Locality	Collector	Date
87868	BELL	Capito	C. E. Burt	7-17-1932
87783–85		9 mi. S. Wasioto	C. E. Burt	7-17-1932
87766-68	CUMBERLAND	4 mi. N.W. Albany	C. E. Burt	7-25-1932
87342		2 mi.S.E. Willow Shade	C. E. Burt	7-25-1932
57267–68	ESTILL		J. Hurter	1904
87818	HARLAN	17 mi. S.W. Cumberland	C. E. Burt	7-17-1932
87439–76		5 mi. S. Lynch	C. E. Burt	7-15-1932
87773–77		Molus	C. E. Burt	7-17-1932
87778-80		3 mi. S.W. Molus	C. E. Burt	7-17-1932
87344–46	KNOTT	1 mi. S.E. Red Fox	C. E. Burt	7-16-1932
87477–90		3 mi. S.E. Red Fox	C. E. Burt	7-16-1932
87781–82	LETCHER	9 mi. N.E. Cumberland	C. E. Burt	7-14-1932
87746–50		11 mi. N.E. Cumberland	C. E. Burt	7-15-1932
87395–438		5 mi. S. Whitesburg	C. E. Burt	7-15-1932
87516–67	METCALFE	2 mi. N.W. Willow Shade	C. E. Burt	7-25-1932
57273	MORGAN		J. Hurter	1899
87889–90	PERRY	Dwarf	C. E. Burt	7-16-1932
87756–59	PIKE	Virgle	C. E. Burt	7-15-1932
87366–94	ROCKCASTLE	1 mi. N.W. Livingston	C. E. Burt	7-13-1932
87347	WAYNE	2 mi S.W. Monticello	C. E. Burt	7-21-1932
87337–40	WHITLEY	Cumberland Falls	C. E. Burt	7-13-1932
87717–45		1 mi. S. Pleasant View	C. E. Burt	7-17-1932
87350		5 mi. S.E. Williamsburg	C. E. Burt	7-13-1932

TOADS

Bufo americanus americanus (Holbrook)

Common toads have been secured as follows:

Number	County	Locality	Collector	Date
87281–82	LAUREL	Corbin	C. E. Burt	7-13-1932
87288		1 mi. S.E. London	C. E. Burt	7-13-1932
87290	LETCHER	8 mi. S. Whitesburg	C. E. Burt	7-16-1932
2472	LOGAN	Russellville	Geo. Bibb	
57465–66	MORGAN		J. Hurter	1902
15–18	NICHOLAS	8 mi. N. Carlisle	G. W. Clay	4-16-1932

Bufo fowleri Hinckley

The following records are available for Fowler's toad:

Number	County	Locality	Collector	Date
85571	CARLISLE	4 mi. N. Arlington	C. E. Burt	6-3-1932
85562–70		4 mi. N.W. Bardwell	C. E. Burt	6-3-1932
87649–50	CLINTON	6 mi. N.E. Albany	C. E. Burt	7-20-1932
88738–53	CUMBERLAND	4 mi. N.W. Albany	C. E. Burt	7-25-1932
79397–403	EDMONSON	Mammoth Cave	L. Giovannoli	6-29-1929
87279–80	HARLAN	Cumberland River at Cumberland	C. E. Burt	7-17-1932
87276		2 mi. N.E. Cumberland	C. E. Burt	7-16-1932
88106		17 mi. S.W. Cumberland	C. E. Burt	7-17-1932
79703	HART	Mammoth Onyx Cave	V. Bailey	9-27-1929
88101–05	MCCREARY	Stearns	C. E. Burt	7-13-1932
106–107	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	9-10-1932
66	POWELL	Red River, Natural Bridge State Park	W. M. Clay	9-7-1932
88098–100	PULASKI	2 mi. S. Eubank	C. E. Burt	7-13-1932
87335–36	WHITLEY	Bank of Cumberland River just above the Cumberland Falls	C. E. Burt	7-14-1932

Young toads taken in McCreary and Pulaski counties on July 13 measured from 9 to 18 millimeters in body length, while one secured in Harlan County on July 17 measured 20 millimeters.

FROGS

Acris gryllus (Le Conte)

Number	County	Locality	Collector	Date
85601–03	CARLISLE	4 mi. N.W. Bardwell	C. E. Burt	6-3-1932
79410–11	EDMONSON	Mammoth Cave	L. Giovannoli	7-4-1929
3555	LOGAN	Russellville	George Bibb	
87245	MCCREARY	2 mi. S. Stearns	C. E. Burt	7-13-1932
87249	WHITLEY	1½ mi. N. Jellico	C. E. Burt	7-13-1932

Pseudacris nigrita triseriata (Wied)

This little frog (No. 85584) was found singing at night from a roadside pool in a grassy district 3 miles north of Bardwell, CARLISLE COUNTY, on June 4, 1932.

Hyla versicolor versicolor (Le Conte)

Metamorphosing young of this form were secured from ponds (with much aquatic vegetation growing in them) in CLINTON (July 20) and CUMBERLAND (July 25) counties.

Number	County	Locality	Collector	Date
85583	CARLISLE	4 mi. N.W. Bardwell	C. E. Burt	6-3-1932
87651–56	CLINTON	6 mi. N.E. Albany	C. E. Burt	7-20-1932
88029	CUMBERLAND	4 mi. N.W. Albany	C. E. Burt	7-25-1932
79414	EDMONSON	Eden Valley ¾ mi. N.E. Mammoth Cave	L. Giovannoli	8-3-1929
79412–13		Mammoth Cave Hotel Grounds	L. Giovannoli	8-8-1929
87186	HARLAN	3 mi. N. E. Cumberland	C. E. Burt	7-16-1932
87206–09	LAUREL	2 mi. N. W. Lily	C. E. Burt	7-28-1932
87205		1 mi. S.E. London	C. E. Burt	7-13-1932
87187	LETCHER	1 mi. N.E. Partridge	C. E. Burt	7-16-1932
87182	MAGOFFIN	½ mi. N.E. Salyersville	C. E. Burt	7-15-1932
57824	MORGAN		J. Hurter	1899
87218	WHITLEY	1½ mi. N. Jellico	C. E. Burt	7-12-1932

Rana catesbeiana Shaw

Bullfrogs are common about the larger ponds and streams.

Number	County	Locality	Collector	Date
85550	CARLISLE	3 mi. N. Bardwell	C. E. Burt	6-3-1932
88036–42	CLARK	6 mi. N.E. Winchester	C. E. Burt	7-15-1932
87647–48	CLINTON	6 mi. N.E. Albany	C. E. Burt	7-20-1932
88034–35	CUMBERLAND	4 mi. N.E. Albany	C. E. Burt	7-25-1932
79404	EDMONSON	Mammoth Cave	L. Giovannoli	1923
87221	LAUREL	1 mi. S.E. London	C. E. Burt	7-13-1932
15	POWELL	Red River, Natural Bridge State Park	W. M. Clay	9-7-1932
87220	WHITLEY	3 mi. N. Williamsburg	C. E. Burt	7-12-1932

Rana clamitans Latreille

Number	County	Locality	Collector	Date
79405–06	EDMONSON	Mammoth Cave	L. Giovannoli	1923
87240–42	LAUREL	1 mi. S.E. London	C. E. Burt	7-27-1932
57973	MORGAN		J. Hurter	1899
74	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	4-15-1932
57974	OLDHAM		J. Hurter	7-25-1913

Rana palustris Le Conte

These frogs occur in habitats with *Rana pipiens* in ponds near woods and at the edge of woodland streams.

Number	County	Locality	Collector	Date
87658–63	CLINTON	6 mi. N. E. Albany	C. E. Burt	7-20-1932
79409	EDMONSON	Bank of Echo River in Mammoth Cave	L. Giovannoli	8-4-1929
79407		In a sink hole near Mammoth Cave	L. Giovannoli	8-4-1929
79408		White's Cave near Mammoth Cave	L. Giovannoli	8-16-1929
79704	HART	Mammoth Onyx Cave	V. Bailey	9-7-1929
100	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	9-9-1932
97	POWELL	Red River, Natural Bridge State Park	W. M. Clay	9-6-1932

Rana pipiens Schreber

The leopard frog is not confined to sylvan habitats to as great a degree as *R. palustris*. It is often found in ponds in grassy areas.

Number	County	Locality	Collector	Date
87657	CLINTON	6 mi. N.E. Albany	C. E. Burt	7-20-1932
88045	CUMERLAND	4 mi. N.W. Albany	C. E. Burt	7-25-1932
3430	LOGAN	Russellville	Geo. Bibb	
108–109	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	4-16-1932
99	POWELL	Red River, Natural Bridge State Park	W. M. Clay	9-7-1932
87177	TODD	1 mi. S. Clifty	C. E. Burt	7-24-1932
87178		5 mi. S. Clifty	C. E. Burt	7-24-1932

LIZARDS

A horned lizard (No. 45054) in the collection of the United States National Museum (a typical example of *Phrynosoma cornutum)* bears the following data: Cleaton, MUHLENBERG COUNTY, Ky. (A. M. Creel, May 17, 1909). It was probably introduced into this locality as a pet.

Sceloporus undulatus undulatus (Latreille)

Number	County	Locality	Collector	Date
79371–72	EDMONSON	Mammoth Cave	L. Giovannoli	8-1929
79706		Bat Cave near Mammoth Cave	V. Bailey	9-1929
87167	HARLAN	11 mi. N.E. Cumberland	C. E. Burt	7-15-1932
4216	LOGAN	Russellville	Geo. Bibb	
87169	MCCREARY	Holly Hill	C. E. Burt	7-13-1932
87165		5 mi. E. Pine Knot	C. E. Burt	7-13-1932
72	POWELL	Natural Bridge State Park	W. M. Clay	9-7-1932
58524–25	ROWAN		J. Hurter	1899
87168	WHITLEY	Cumberland Falls	C. E. Burt	7-14-1932

Cnemidophorus sexlineatus sexlineatus (Linné)

Two six-lined race-runners (Nos. 79373-74) were collected at Mammoth Cave EDMONSON COUNTY, by L. Giovannoli in July 1929.

Leiolopisma laterale (Say)

A brown-backed skink (No. 5009) was taken at Russellville, LOGAN COUNTY, by George Bibb.

Eumeces fasciatus (Linné)

In EDMONSON COUNTY, five-lined skinks have been obtained by L. Giovannoli at Eden Valley ½ mile northeast of Mammoth Cave (No. 79377, July 28, 1929), Mammoth Cave Hotel (Nos. 79375-76, July 15, 1929) and at the mouth of Mammoth Cave (No. 79378, Aug. 22, 1929).

In FULTON COUNTY, two specimens (Nos. 45057-58) were secured at Hickman by G. A. Coleman on July 23, 1892.

SNAKES

Carphophis amoena helenae (Kennicott)

Worm snakes have been taken at Mammoth Cave, EDMONSON COUNTY (Nos. 79393-94, L. Giovannoli, 1929); Stithson, HARDIN COUNTY (Nos. 29173-74, E. T. Carrico, Mar. 29, 1901); and in JEFFERSON COUNTY (No. 56171, J. Hurter, 1892).

Diadophis punctatus edwardsii (Merrem)

Mr. L. Giovannoli took this ring-neck snake at Horse Cave, HART COUNTY, in 1929 (No. 79390).

In 1932 I secured a specimen (No. 87317) 1 mile northwest of Livingston, ROCKCASTLE COUNTY, on July 13 in a moss pocket in a rock ledge, where it was bathed by seepage from the cold water of a mountain streamlet. Another example was found in a rotted log 6 miles southwest of Corbin, WHITLEY COUNTY, on July 14.

Heterodon contortrix (Linné)

Number	County	Locality	Collector	Date
17470	BARREN	Glasgow	W. T. Owsley	1891
79379	EDMONSON	Mammoth Cave	L. Giovannoli	1929
39009	HARDIN	Stithton	E. T. Carrico	5-1909
79701	HART	Mammoth Onyx Cave	V. Bailey	1929

Opheodrys aestivus (Linné)

A rough green snake (No. 87315) was found dead on the road near woods 6 miles southeast of Burkesville, CUMBERLAND COUNTY, on July 25, 1932.

Coluber constrictor constrictor (Linné)

Two blacksnakes were obtained at Mammoth Cave, EDMONSON COUNTY, by L. Giovannoli in 1929 (Nos. 79381-82).

Elaphe obsoleta confinis (Baird and Girard)

A specimen of this snake (No. 56494) in the Hurter Collection was taken in CLARK COUNTY in 1899. It shows the coloration described for this phase of the species.

Elaphe obsoleta obsoleta (Say)

Pilot blacksnakes are common in wooded districts and dead specimens are often found in the road in such areas.

Number	County	Locality	Collector	Date
79380	EDMONSON	Mammoth Cave	L. Giovannoli	1929
	HARLAN	11 mi. N. E. Cumberland	C. E. Burt	7-15-1932
79700	HART	Mammoth Onyx Cave	V. Bailey	1929
87308	LETCHER	8 mi. S. Whitesburg	C. E. Burt	7-16-1932
85	NICHOLAS	2 mi. N. Carlisle	W. M. Clay	8-31-1932
87307	WHITLEY	4 mi. S.E. Williamsburg	C. E. Burt	7-13-1932

Lampropeltis getulus nigra (Yarrow)

A black chain-snake (No. 79383) was secured at Mammoth Cave, EDMONSON COUNTY, by L. Giovannoli in 1929.

Lampropeltis triangulum triangulum (Lacépède)

Milk-snakes have been taken at Stithson, HARDIN COUNTY (No. 39010, C. T. Carrico, June, 1909); and 8 miles north of Carlisle, NICHOLAS COUNTY (No. 94, W. M. Clay, Aug. 31, 1932).

Natrix septemvittata (Say)

The ventral dark spots or stripes of this watersnake become progressively duller with age, being obsolete in old specimens.

In NICHOLAS COUNTY, W. M. Clay has taken a specimen (No. 63, Aug. 31, 1932) at the edge of Panther Creek about 8 miles north of Carlisle; and in SCOTT COUNTY, he has secured examples (Nos. 20, 23, 27-28, 30-42, 67-71, Sept. 16, 1932) from North Elkhorn Creek about 3 miles south of Georgetown.

Natrix sipedon sipedon (Linné)

This water-snake shows dark markings on the ventral surface which tend to become sparse anteriorly in various Kentucky specimens, and at times these crescents may lack red for the most part, even posteriorly.

Number	County	Locality	Collector	Date
87328	CLINTON	6 mi. N.E. Albany	C. E. Burt	7-20-1932
79384	EDMONSON	Pond 100 yds. N.E. entrance to Mammoth Cave	L. Giovannoli	7-15-1929
79385		2 mi. N. Mammoth Cave	L. Giovannoli	7-26-1929
38045	JOHNSON	Jones Creek	Holmes	9-20-1907
87327	LETCHER	5 mi. N.E. Whitesburg	C. E. Burt	7-15-1932
56642	MORGAN		J. Hurter	1899
86–87	NICHOLAS	8 mi. N. Carlisle	W. M. Clay	9-10-1932
54–62	POWELL	Red River near Natural Bridge	W. M. Clay	9-7-1932
43–48	SCOTT	N. Elkhorn Creek 3 mi. S. Newton	W. M. Clay	9-16-1932
87326	WHITLEY	Cumberland Falls in Cumberland River	C. E. Burt	7-14-1932

Storeria dekayi (Holbrook)

One of these snakes (No. 79391) was secured at Mammoth Cave, EDMONSON COUNTY, by L. Giovannoli in 1929.

Storeria occipito-maculata (Storer)

This snake was found at Mammoth Cave, EDMONSON COUNTY, by L. Giovannoli in 1929 (No. 79392).

Thamnophis sirtalis sirtalis (Linné)

Number	County	Locality	Collector	Date
17469	BARREN	Glasgow	W. T. Owsley	1891
79386–89	EDMONSON	Eden Valley 1 mi. N.E. Mammoth Cave	L. Giovannoli	7-24-1929
56063	MORGAN		J. Hurter	1899
93	NICHOLAS	Panther Creek about 8 mi. N. Carlisle	W. M. Clay	4-16-1932

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THE PRIMITIVE GALUMNINAE (ORIBATOIDEA-ACARINA) OF THE MIDDLE WEST

ARTHUR PAUL JACOT

This paper in large part redescribes and figures species originally described by Nathan Banks (1, 2) and Henry Ellsworth Ewing (6, 8). The figures of Ewing's species are of the holotypes in Dr. Ewing's collection, kindly loaned me for study. To these are added other species, and distribution records of some of the primitive species of this subfamily. Of Bank's species I have seen the types and he has very kindly turned over to me for study the bulk of his material.

The Galumninae (12, p. 277) are Oribatidae having (in the adult stage) the pteromorphae very large, hinged along the dorsal edge, extending downward to cover part of the ventral plate and forward to cover the sides of the cephaloprothorax to distal end of the lamellar band, thus covering over an extensive but shallow recess (leg cupboard) in the sides of the abdomen, for receiving the legs when folded upward at the coxae and down at the genuals; lamellae and tectopedia I forming low blades at most, or lamellae reduced to flattened bands closely appressed to cephaloprothorax, extending from dorsoposterior corners of cephaloprothorax to anterior ends of ventral plate wings, tectopedia I then internal; pseudostigmata in dorsoposterior corner of cephaloprothorax; ungues usually triheterohamate, sometimes trihomohamate.

Type genus: Galumna (10, p. 612).

Genus PROTOKALUMMA (13, p. 5)

Galumninae having lamellae developed as narrow blades which project above face of cephaloprothorax, especially at their distal end, where they usually curve mesad as a short stay and/or escarpment on the frons of the cephaloprothorax; this extra thickness of chitin often gives the appearance of a translamella but differs in that a translamella is a projecting

chitin blade while this is but a steeper slope on the face of the cephaloprothorax (figures 10); tectopedia I developed as a ridge bounding anterior end of leg cupboard; pteromorphae without sharp tooth or distinct notch on its margin but gently undulate, and without transverse groove across its disc; porose areas poorly developed or represented by pseudofissurae; ventral plate wings short, slender, leaving tectopedia entirely exposed; sides of ventral plate forming an obtuse angle with ventral face; tectopedia with bristles; bristle of parasterna I not gular in position; genital covers with only one pair of marginal bristles; subanal muscle plate crescentic, considerably anterior to aperture; preanal bristles anterior to anterior edge of anal aperture; anal aperture with sides subparallel; color tan.

Type species: *Oribata depressa* (1, p. 7).

Protokalumma depressum (13, p. 5).

Figs. 1-10

Diagnostic characters: Anterior end of pteromorphae rounded; pseudostigmatic organs clavate, the head nearly as long as the pedicel, curved at juncture of the two, with five to six very short bristles, the longest projecting from the distal end. In some aspects the head appears bluntly rounded (figure 3), in others truncate or with oblique distal end (figure 2), at least two, widely spaced bristles terminate this blunt, distal end; lamellar buttresses extending a short distance mesad of lamellar bristles, which are inserted mesad of bend; a long, slender pseudofissura on same longitudinal plane as the stout, grub-like mesonotic porose areas (figure 1); bristles of genital covers (figure 1) inserted nearer lateral edge of covers than to median edge; no paramesal bristle insertions; preanal bristles more remote than diameter of anal aperture; pseudofissurae of anal aperture near sides of covers; anterior pair of anal cover bristles inserted near center of cover; postanal bristles long, extending well beyond posterior edge of abdomen, distal ends strongly curved.

Description.—Size medium (0.48x0.38 mm.); form, seen from above (figure 1), slenderly pyriform, rostrum distinct, seen from side, low, depressed (in figure 4 the body is

lower behind than before because the notogaster is drawn down to its maximum extent) rostrum not differentiated in lateral profile; notogaster forming an angle with cephaloprothorax, especially when notogaster is entirely drawn down; lamellae at proximal end closely appressed as in Galumna, the distal ends curving mesad, projecting as slight terraces or escarpments along their lateral rim, extending well beyond lamellar bristles but not joined, the frons seeming to be longitudinally depressed in the center; tectopedia I represented by a slender, bent, chitin wall (figures 3 and 4); rostral bristles fine, distally rough, nearly touching well in advance of the rostrum, inserted at base of a slight evagination of the cephaloprothorax wall; lamellar bristles long, reaching out well beyond rostral, slightly and distantly burred; interlamellar bristles still longer (foreshortened in figure 1), burred, inserted much nearer to posterior edge of cephaloprothorax than to lamellae, base half encircled by a thickened rim (figure 3); pseudostigmata not projecting, the organs as above described with two to three rows of eight to nine "oil globules." In Maine specimens it is stouter and shorter, with a more marked angle.

Notogaster low (figure 4), flattish, without bristles, the insertions and pseudoforamina as indicated in figures 1, 3, and 4; anterior porose areas not discerned, adalar porose areas very small, bluntly ovate, lower edge open, as a stout pseudofissura; mesonotal porose areas prominent though reduced to a stout pseudofissura, others indistinct; pteromorphae with faint, unbranched radiating veining, all edges broadly rounded, ventral edge slightly undulate (figure 4), pseudofissura slender, anterior edge thickened for a short distance beyond angle.

Ventral plate (figures 1 and 4) deeper than notogastral, slightly undulate; bristles well developed; tectopedia II narrow, thin, with bristle inserted near middle; tectopedia III slight, with rounded distal end, inserted on posterior face, bristle curving under it; tectopedia IV well formed, cuneate, with bristle inserted near posterior end; apodemata I very short by reason of the lateral half not being attached to ventral plate, with flaring mesal end, the ends usually enclosing

less than a right angle; apodemata II-III long, reaching to edge of aperture frame, with mesal end slightly enlarged as a ball or with short, diverging ends; apodemata IV very short, distal end removed from genital aperture by width of a genital cover at its posterior end; lacunae faint; first and second pair of sternal bristles subequally remote, third pair more approximate, but less so than marginal bristles of genital covers; all these bristles with oblique channel and larger ental opening; genital aperture small, with sides strongly converging, rather straight, posterior edge deeply undulate, anterior edge strongly bowed; cover bristles arranged in two closely spaced pairs, the pairs being distant from each other; anal aperture rather close to posterior edge, with sides parallel, almost straight, anterior corners well formed, distinct, muscle ridge long; mesal pair of postanal bristles more approximate than sides of aperture, lateral pair more posterior than transverse plane of and much more remote than posterior pair of cover bristles; pseudofissurae rather distant from edge of aperture; anterior pair of cover bristles much more remote than posterior pair; other bristles as in figure 1.

Camerostome broad; labium well developed, bristles near anterior edge, remote; palps five segmented (figure 9) with clavate, curved, styliform bristle inserted near distal end of distal segment.

Legs I (figure 5) rather stout: tarsi stoutly clavate, terminating with a fairly long, triheterohamate unguis; distal half of dorsal face with four bristles, proximal rather short, fine, second twice as long, stiff, third the stoutest, strongly curved toward hooks, fourth fairly long, fine; distal half of dorsal face with two pairs of fine bristles, the proximal pair extending to beyond hooks when these are flexed at right angles with the article; ventral face with the usual ciliate bristles, the proximal a pair inserted slightly proximad of transverse plane of dorsoproximal, second pair inserted unusually far distad, that is on transverse plane of dorsoproximal pair; two lateral bristles as in figure 1; a mesal bristle inserted on transverse plane of proximolateral (not figured). Tibiae obliquely clavate, drawn out on dorsal side to form a stout, triangular base for insertion of major and dorsodistal bristles,

the latter being half the length and caliber of the major; ventral edge with the usual ciliate bristle, inserted at distal third of the length of the article; a slender subdorsal bristle inserted slightly proximad of same transverse plane; a lateral and a ciliate mesal bristle inserted more distally than the ventral bristle. Genuals stoutly cuneiform; ventromesal face with a ciliate bristle inserted at middle of segment; dorsal face with a very long, fine, down curved bristle, reaching to beyond distal end of femur, inserted beyond distal edge of segment; lateral bristle medium long, fine, inserted very near distal edge of segment. Femora broad, spatulate, with stout pedicel; dorsal edge with two, short, angularly bent, barbed bristles, the proximal inserted proximad of center of body of segment, the distal one inserted midway between proximal bristle and distal end of segment; ventral edge with two, fine, curved bristles, the proximal one inserted at juncture with pedicel. (Judging from a whole mount there are *two* bristles at this point, but only one is to be found in several dissections). The distal one inserted on the transverse plane a little in advance of dorsoproximal; a fine lateral bristle inserted on transverse plane a little proximad of dorsodistal bristle. Trochanter minute.

Legs II (figure 6) slightly longer. Tarsi as stout, proximal half of dorsal face with only three bristles corresponding to second to fourth of tarsi I, the stoutest nearly straight; ventral face similar, a ciliate mesal bristle inserted on transverse plane just proximad of stout dorsal bristle. Tibiae strongly bent ventrad at juncture with the better developed pedicel, dorsal projection quite slender; no dorsodistal bristle; a ciliate lateral bristle inserted on transverse plane distad of ventral; a ciliate, mesal bristle inserted near distal edge (not figured). Genuals shorter than genuals I, with a lateral bristle inserted slightly distad of center, and two ciliate bristles, one inserted on distal edge of ventral face the other distad of center of mesal face. Femora, seen from below, strongly curved, seen from side, broad (deep), flat, with very short pedicel; dorsal bristles more distally inserted, more depressed, no bristle at juncture with pedicel; ventral bristle medium long, ciliate, straight, inserted on transverse plane just proximad of ventrodistal; two lateral bristles inserted as in figure

6. I have some dissections in which there is but one lateral bristle about midway between the usual two. A rather short bristle inserted on mesal side of pedicel is usually lost in dissections.

Legs IV (figure 8) slender, longer than legs I. Tarsi clavate; dorsal face with two bristles, the proximal straight, smooth, inserted at middle of segment, the distal one ciliate, inserted slightly distad of distal fourth of segment, also a rather short terminal bristle; ventral face with the usual ciliate bristles. Tibiae cuneiform; major bristle barely extending to base of hooks, the two ventral face bristles ciliate, the proximal inserted proximad of transverse plane of major bristle, the distal one inserted close to distal edge; a ventrolateral, ciliate bristle inserted on transverse plane of major bristle. Genuals slender, curved; with a stiff, dorsal face bristle inserted near distal end; a ciliate, ventral face bristle inserted near distal end; a ciliate, ventral face bristle inserted on same transverse plane. Femora broad (deep), oval, dorsoproximal corner high, angled, pedicel short, stout, springing from ventroproximal corner of segment, with slight ventral ridge; dorsal face bristle rather long, ciliate, inserted just distad of center; ventral face bristle smooth, fine, inserted at distal fourth of body of segment. Trochanters helmet-like, ventral edge straight, with fine, straight bristle inserted at distal end; ventroproximal angle drawn down to form an auricle.

Legs III (figure 7) shorter, stouter. Dorsal face of tarsi with two dorsoproximal bristles inserted near each other, another pair inserted near middle of segment, a single one inserted at distal fourth of the segment. Tibiae with more slender pedicel and stouter distal end; major bristle inserted on a broad, low projecting base; ventral face with but one bristle inserted near distal end of segment; lateral bristle inserted more proximad than major. Genuals shorter, more curved; the two bristles shorter, inserted near center of segment. Femora broadest proximad of middle, dorsoproximal angle rounded down; the dorsal bristle inserted on transverse plane slightly distad of proximal third of body of segment; ventral edge with keel slightly broader (deeper) than in femora IV; ventral bristle ciliate on two sides, longer than in femora IV,

inserted slightly more distad; a dorsolateral bristle inserted a little distad of dorsal bristle. Trochanters more oblique, pedicel more slender; ventral bristle longer, a lateral bristle inserted slightly dorsad of middle of distal edge.

Dimensions.—From the measurements of seven males and seven females from Queens Woods, Long Island, N. Y. (a few miles from the type locality), the dimensions of the smallest male, the average of the seven males, average of the fourteen, average of the seven females, and the dimensions of the largest female presented, respectively:

Total length of body	439	463	484	505	540
L. of notogastral plate	360	375	387	400	435
Breadth of same	250	268	278	288	300
Length of pteromorphae	245	258	266	275	290
Interlamellar bristle span	63	66	69	73	78
Median l. of ventral plate	335	356	378	400	425
Camerostome to gen. apert.	85	85	87	89	93
L. of genital aperture	55	60	63	66	70
Breadth of same	50	52	57	62	65
Gen. apert. to anal apert.	115	119	127	135	153
L. of anal aperture	83	87	90	93	98
Breadth of same	85	91	94	97	105

Thus the genital aperture is slightly longer than broad and the anal aperture is slightly broader than long.

Material examined:—Three specimens from epigeous moss of evergreen woods, Cliff Island, Casco Bay, *Maine;* taken August 15th 1919 by Lydia Jacot, slide no. 1933o1. *Connecticut:* A male from moss on rocks along trickle (probably also rotten roots) in Calhoun Pines, Cornwall; taken August 26th 1932, slide 3253o4. One specimen from open cushion moss, upland swamp one mile west of East Village, Monroe; taken May 31st 1919, slide 1931o2. One specimen from under face of old board, edge of upland swamp woods, East Village, Monroe; taken August 4th 1930, slide 3230o1. Two speciment from decayed, fallen, oak branches, sand ridge, northeast of North Haven;* *New York:* Five specimens from marsh, Freeville; taken May 20th by Nathan

* Taken September 20, 1932, slide 327101.

Banks, slides 26B75a and -b. Twelve specimens from under face of stones, boards and bark of twigs, Six Mile Creek, south of Ithaca; taken April 14th 1917, slide no. 17601. One specimen from rotten wood or under bark slab, woods, Glen Cove, Long Island; taken May 8th 1920, slide 209n1. Eighty-seven specimens from decaying logs and sticks lying among dead leaves, Queens Woods, Long Island; taken May 3rd 1919, slides 19280la and -b. Eight specimens from Hydnum, Monmouth Junction, *New Jersey:* taken by Harry B. Weiss, slide 26B52. *Virginia:* One specimen from under board, Falls Church; taken August 11th by N. Banks, slide 26B76. One specimen from under stick on ground, Falls Church; taken September 13th by Banks, slide 26B69b. One specimen from under loose bark of dead pine stick, Falls Church; taken in April by Banks, silde 26B84b. One specimen from Falls Church; taken May 2nd by Banks, slide 26B67c. *Ohio:* One specimen from bluegrass sod, Mt. Logan, Chillicothe; taken by A. E. Miller, May 25th 1924, slide 32M91o. One specimen from "*Pinus strobus,* Wooster; October 28, R. L. Miller Coll." *Illinois:* Two specimens from polypore fungus on under side of fallen branch in shade, University woods, Urbana; taken August 29th 1927 by Miller, slides O-11.1-27 and O-11.5-27 (Miller coll.). Twentyseven specimens from area of two square inches on lower side of dry sector of pin oak stump in shade of large pin oak in open pastured woods, Hillsdale; taken July 9th 1927 by Miller, slide 32M117o. *Wisconsin:* One specimen from Madison, C. B. Hardenberg, Cornell Univ. coll. no. 1415 sub J1. Thirty-five specimens in and about fungus on lower side of fallen black oak branch in open pastured woods, Walworth; taken July 12th 1927 by Miller, slide 32M111o. One specimen from under dry bark of fallen silver maple branch under its tree in open, grassy, very dry pasture, Brettendorf, *Iowa;* taken July 8th 1927 by Miller, slide 32M114o2.

Older records:—Type locality: Sea Cliff, Long Island, N. Y. (1, p. 7). From Vaccinium corymbosum (the blueberry), at Whitesbog, N. J.; taken September 27th by H. K. Plank (15 p. 109). Several specimens under bark, Urbana, Ill. (7, p. 97).

Known distribution: Southern Maine to Virginia west to Iowa; chiefly upper austral. *N. aurantiaca* (14, p. 16) from Bremen, Germany (from fallen leaves) may be this species.*

Habitat: From the above records, this species seems to prefer decaying wood. The few individuals found in moss are undoubtedly accidental as there are many moss lots from all over its geographical area without this species. It is a species of the woodland floor.

The three specimens from Maine have the pseudostigmatic organs shorter, stouter (especially the pedicel), more angularly bent; the bristles of the ventral plate are strikingly dislocated; the specimens are larger. The condition of the ventral plate bristles suggests hybridization with a northern species.

Eggs: The largest number of eggs observed in any one female was six.

Protokalumma pterotum (2, p. 8)

Figs. 11-12

Diagnostic characters: Anterior end of pteromorphae rounded; pseudostigmatic organs (figure 11) longer, finer, straight, with shorter, more slender head and very slender pedicel, distal end of head pointed and terminated by a single bristle or two bristles originating at same point; lamellar buttress often faint but joined across the frons as a faint line or escarpment; mesonotic porose areas well developed, their pseudofissura very prominent; pseudoforamina and fissurae arranged as in figure 12; bristles of genital covers nearer median edge of cover than to lateral edge, more regularly spaced out; paramesal bristles present; preanal bristles more approximate than sides of anal aperture; postanal bristles short, very fine, straight, difficult to discern, not extending beyond edge of notogaster; anal cover bristles subequally distant from median edge of covers; sides of anal aperture quite

* Dr. A. C. Oudemans, under date of May 16th, 1921, advises me that the genital covers have each the four bristles close to outer edge of covers and that the preanal bristles are present. The figure of the pseudostigmatic organs very much resembles those of *P. depressa*.

curved, with anterior corners much rounded off, the pseudofissurae anteriad of center and close to edge.

As this species resembles the former so closely in other respects no detailed description is added.

Dimensions: Three males and three females from Great Falls, Va. are measurable. A male and a female from Falls Church, Va., are quite average except that their breadth measurements are far above any of those from Great Falls. Their measurements are added except for the breadths. The arrangement of the table is as in the preceding species but the averages are for four individuals (or eight).

Total length of body	550	558	563	568	595
L. of notogastral plate	420	430	437	445	460
Breadth of same	308	320	323	326	328
Length of pteromorphae	303	311	312	313	328
Interlamellar bristle span	63		70		71
Median l. of ventral plate	410	427	429	432	455
Camerostome to genit. apert.	91		102		105
L. of genital aperture	61	63	66	68	70
Breadth of same	66	69	70	71	74
Gen. apert. to anal apert.	124	138	139	141	155
Length of anal aperture	98		101		105
Breadth of same	94		98		102

A comparison of the general averages of these two tables shows that this species is narrower, the anal aperture is narrower than broad, the cephaloprothorax is longer, the genital aperture is relatively much shorter. The Illinois specimens average larger.

Material examined: *Virginia:* Sixteen specimens from Falls Church; taken by N. Banks, slide 26B70e. Eleven specimens from under bark, Great Falls; taken September 9th by Banks, slides 26B113a and -b. *Illinois:* Sixteen specimens from under loose bark on fallen log, Dodson's Wood's Urbana; taken June 7th 1926 by A. E. Miller, slides O-2.1-26 and O-2.2-26 (Miller coll.). One male from under loose bark of untopped, fallen white oak in northeast corner of Dodson's Woods, sunny exposure, two feet from ground, Urbana; taken June 6th 1927 by Miller, slide 32M125o.

Older records: Type locality: Falls Church, Va.

H a b i t a t : Like the preceding this is a species of rotten wood on the forest floor.

Protokalumma fissuratum (5, p. 128, pl. 2, fig. 22)

This species, by the position of the insertion of the lamellar bristles on the transverse branch of the lamellae, that is on the *dorsal* face of the cephaloprothorax, is allied with the preceding. It differs in its major pseudofissurae which lie parallel with the transverse plane of the body. Judging from the figure, the pseudostigmatic organ head is without barbs.

T y p e : From Columbia, Missouri; collected by Cyrus R. Crosby, sent to Pietro Pavesi; now in the Agricultural Entomological Station at Florence, Italy.

Protokalumma corticis (8, p. 117, pl. 8, fig. 12)

Figs. 13-14

Rostrum, seenfrom above, slender; pseudostigmatic organs (figure 13) rather short, clavate, the head nearly as long as the stout pedicel, unbarbed, carbon black, diagonally truncate; lamellar bristles faintly barbed, interlamellar evidently smooth; lamellae not turned mesad as much as in *P. depressum* the bristles inserted at *lateral* corners; anterior edge of pteromorphae bluntly pointed, though not emarginate or notched; adalar porose areas larger than pseudostigmata; pseudofissurae and insertions as in figure 14, notogaster slightly evaginate posteromedially; tectopedia II much larger than in *P. depressum*, resembling those of *Parakalumma robustum* (13, pl. 2, figs. 6, 8); tectopedia III double, that is with a more slender, pointed, reduplication of itself on the posterior side (figure 14), bristle long; tectopedia IV also better developed; apodemata longer than usual in this genus, more like those of Parakalumma; bristle of parasterna I halfway between apodemata I and edge of camerostome; middle pair of sternal bristles much more remote than in anterior and posterior pairs, close to posterior pair; bristles of genital covers nearer lateral than median edge of covers, anterior bristle close to anterior margin, posterior bristle close to posterior margin; paramesal bristles further from genital aperture than greatest diameter of genital cover; preanal bristles

more remote than diameter of anal aperture, anterior to its anterior edge; anal aperture with sides subparallel, pseudofissurae fairly long, slightly anteriad of center, close to edge; postanal bristles same as in *P. depressum;* anterior pair of cover bristles anteriad of pseudofissurae. There may be a marginal bristle on genital covers but I am unable to see it definitely; ventral plate truncate posteromedially.

Dimensions: In the first column are the dimensions for this species, in the next column the dimensions for the next species, the holotype in each case, in microns.

Total length of body	715	718
Total breadth	432	456
Length of notogaster	577	560
Length of pteromorphae	322	318
Interlamellar bristle span	91	95
Median length of vent. plate	573	550
Camerostome to genit. apert.	131	131
Length of genital aperture	80	86
Breadth of same	74	82
Gen. apert. to anal apert.	95	100
Length of anal aperture	127	128
Breadth of same	127	131

Type: A male from under rotting willow bark, Baldwin, Michigan; taken August 22nd 1908 by J. Douglas Hood, collection of H. E. Ewing.

This unique individual, is intermediate between *P. depressum* and *Parakalumma robustum*. I retain it in Protokalumma because the lamellae are broader and more prominent; there is no emargination on anterior edge of pteromorphae; there is no colorless area at anterior end of notogaster; the preanal bristles are anterior to anterior edge of anal aperture. It is near Parakalumma but has not yet attained it. I do not think it is a hybrid because the pseudostigmatic organs are quite different from either, and unbarbed.

Protokalumma salicis (8, p. 117, pl. 8, fig. 11)

Figs. 15-16

Similar to *P. corticis* but interlamellar bristles less stout, more flexible; pseudostigmatic organs more slender (figure

15) not bent at juncture of head and pedicel, head decurrent onto pedicel so as to make no distinction between the two, eye of head at least three times as long as broad; anterior end of pteromorphae rounded; porose areas larger (compare figures 14 and 16); insertions and pseudofissurae of notogaster differently situated (compare figures 14 and 16); no distinct swelling on posterior end of notogaster; posterior end of ventral plate not truncate; ridge (?) joining postanal bristles distinct and well developed; all bristles much longer, though their insertion is strikingly similar; pseudofissurae more anteriad so that anterior pair of anal cover bristles are on transverse plane crossing pseudofissurae; anterior and posterior pair of genital cover bristles distant from edge of cover.

Dimensions appear in the second column of the above table. The outstanding difference is sexual.

Type: One female from under rotting willow bark, Baldwin, Michigan; taken August 22nd 1908 by J. D. Hood, collection of H. E. Ewing. Evidently taken with the preceding, which makes one wonder at Jordan's law of distribution.

These two species form a distinct pair, intermediate between *Protokalumma depressum* and *Parakalumma robustum*.

I am of the opinion that these are sex dimorphics of one species, though not yet recorded in other species of Galumninae; or hybrids.

Genus PARAKALUMMA (13, p. 6)

Galumninae having lamellae developed as narrow blades which project as keels from sides of cephaloprothorax, especially at their distal end which does not curve mesad; tectopedia I very much reduced to fused to lower edge of lamellae; pteromorphae emarginate or retuse in front so as to leave a single, acute angle or tooth on anterior edge; tectopedia with bristles; bristles of parasterna I not gular; genital covers with only one pair of marginal bristles; subanal muscle plate crescentic, considerably anterior to aperture; preanal bristles near anterolateral corners of aperture; anal aperture squarish, sides subparallel; color tan, anterior end of notogaster usually colorless.

Type: *Neoribates lydia* (11, p. 169).

Parakalumma robustum (13, p. 8)

Body broad; rostrum narrowed, its sides forming an acute angle; lamellae well developed, distal ends at lateral edge of cephaloprothorax, with a slight mesal buttress; interlamellar bristles very long and stout; pteromorphae slightly concave-sinuate posteroventrad of point; pseudostigmatic organs pointed, with a long, slender, burred head; camerostome narrow; genital cover bristles equidistant between lateral and mesal sides of covers; paramesal bristles absent; preanal bristles posterior to anterior edge of anal aperture; postanal bristles short.

In the detailed description and figures of this species (13, pp. 8-16, pls. 1-3) the following bristles are omitted; at lateral end of parastern III a fairly long bristle inserted nearer apodemata II-III than IV; posterior to mesal end of parasterna IV, a faint insertion more distant from apodemata II-III than the parasternal bristle; posterior to lateral end of parasterna IV a short bristle inserted between the images of acetabulae III and IV but nearer III; paramesal bristles represented by usually two to three minute pseudoforamina. The positions of these bristles is very similar to those of the asiatic species figured on plate 6 (13). The mesal postanal bristles are often more remote (that is opposite center of covers) than figured; the lateral pair are then also more remote. The pteromorphae often have a slight tooth at distal end. The lateral mesonotic areas are often represented by a pseudofissura on transverse plane considerably anteriad to the mesal mesonotic. I am now of the opinion that the phenomenon illustrated in figure 5 (13) is caused by fungal hyphae.

Oribates centropterus (3, p. 6) is certainly this species. Its author, in his revision of the Galumninae (5), makes no further mention of it. The only discrepancy in the description is the color (pitch black) but that is no worse than calling *O. robusta* shining black (5, p. 128).

Additional material examined: *Illinois:* Three specimens from under side of board lying in moist stream bed, three miles southwest of Oakwood; taken August 22nd 1927 by August E. Miller, slide 0-4-27 (Miller coll.). Two specimens from moist under side of newly cut black oak fence post lying

on ground, Mt. Vernon; taken August 6th 1927 by Miller, slide 0-21-27 (Miller coll.). Three specimens from under loose, moist bark on fallen tree, Brownfield's woods, Urbana; taken May 1st 1926 by Miller, slide 0-20-26 (Miller coll.). *New York:* An eggless female from damp oak and pine leaves, poultry woodlot, level hilltop, moderate shade, Cornell campus, Ithaca; taken May 26th 1928 by Robert Harwood, slide 78B2 (Cor. Univ. lot 845). Thirteen specimens from upper half of five inch layer of wet chestnut oak, basswood, and mountain maple leaves on steep, south, rocky slope of glen two miles north of Ithaca; taken June 8th 1928 by Harwood, slide 87A3 (Cor. Univ. lot 845). Twelve specimens from upper half of five inch layer of damp, black oak, red oak, beech, and mountain maple leaves on gradual, north slope, on Six Mile Creek, Ithaca; taken May 11th 1928 by Harwood, slide 76A1. *Connecticut:* One specimen from oak leaf mould and duff, sand ridge, northeast of North Haven; taken September 14th 1932, slide 3267o1. Two specimens from scruboak litter, base of clump, sand barrens between North Haven and Northford; taken September 14th 1932, slide 3277o1.

Distribution: northern Connecticut south to Florida and west to Missouri. Type locality: Sea Cliff, Long Island, N. Y.

Habitat: Dead leaves and forest floor litter, local.

Genus NEORIBATES (5, p. 127)

Galumninae with mesal edge of lamellae evanescent except the anterior end; tectopedia I almost completely invaginated, leaving a slender external ridge curving ventrad toward anterior end of tectopedia II (13, pl. 5, fig. 35), distal end distinct, terminated by the bristle; pteromorphae without distinct emarginations (though ventral edge may be slightly undulate), and without transverse groove; porose areas not well developed, at most grublike or fissurelike structures; some of the tectopedia with bristles; bristles of parasterna I not gular; each genital cover with only one marginal bristle; subanal muscle plate V-shaped, considerably anterior to aperture; preanal bristles posterior to anterior edge of aperture (that is subparanal); color tan.

Type: *Oribata roubali* (4, p. 385; 5, p. 128, pl. 2, fig. 20).

Neoribates quadrisetosus (9, p. 161, pl. 3, fig. 42).

Body fairly broad; rostrum broad and blunt, its sides forming an obtuse angle; pteromorphae extending well beyond lamellae; pseudostigmatic organs clavate, head distinct, much shorter than pedicel, with rounded distal end, furnished with slender barbs; genital cover bristles near longitudinal center of covers; paramesal bristles more remote than width of anal aperture; postanal bristles very long, extending well beyond posterior edge of abdomen, the lateral ones far more remote than width of aperture.

Since this species is described and figured in detail in my earlier paper (13, p. 16, pls. 4 and 5) it will not be repeated here.

Additional material examined: *Illinois:* University Woods, Urbana; taken August 29th 1927 by A. E. Miller: At least 276 specimens from twelve square inch area of *Poria* sp. and another polypore on under side of fallen branch in shade, slides 0-11.1-27 to 0-11.5-27 (Miller coll.); at least 241 specimens from ten square inch area of an old *Hypocreales* fungus with new growth, slides 0-10.1-27 to 0-10.4-27 (Miller coll.); thirty-five specimens, moving about on top of dead and rotted stump (lichens present), slides 0-19.1-27 and 0-19.2-27 (Miller coll.). *New York:* one specimen from pine leaf mould and duff, foot of pine tree, east slope of Pleasant Hill, Etna, N. Y.; taken October 15th 1932, slide 3290o1.

Known distribution: Central New York to Illinois. Type locality: Xenia, Ohio.

Habitat: From the above, woody fungi seem to be the choice substratum of this species.

Genus **NEORIZETES** gen. nov.

Galumninae with lamellae reduced to closely appressed bands or straps curving down to anterior end of ventral plate wings; tectopedia I chiefly ental; pteromorphae without transverse groove, the ventral edge with a distinct notch; abdomino-cephaloprothoracic suture distinct; porose areas not developed; bristles of parasterna I gular in position; each geni-

tal cover with two marginal bristles; preanal bristles paranal in position; color tan.

Type: *Oribata rugosala* (6, p. 120, pl. 3, fig. 8).

The genus is peculiar in that it has all the appearance of Zetes but lacks the transverse groove of the pteromorphae which have an *oblique* notch. Moreover there are no porose areas. It therefore is a good illustration of dis-synchronous evolution in the case of these characters.

Neorizetes rugosala comb. nov.

Figs. 17-19

Since this species is based on one female, and since she was received crushed flat by the drying out of her glycerine jelly medium, the characters here included must be incomplete. I am unable to find the pseudostigmatic organs or to see the rostral bristles; lamellar bristles moderately long, rather fine, inserted some distance mesad of lamellae (figure 17); interlamellar bristles longer and stouter than lamellar, insertion large and distinct (in the figure it appears far from tectopedium I because of the flattening out of the cephaloprothorax); lamellae with mesal edge slightly undulate, originating near insertion of interlamellar bristles (in normal dorsal aspect, this high origin is often not evident, though it appears clearly in lateral aspect); tectopedia I as usual in Zetes. Figure 17 shows anterior edge of pteromorpha with the wavy wrinklings (veining) which gave the species its specific name. The original figure of the pteromorpha (6, p. 120, pl. 3, fig. 8) is characteristic. Although the specific name indicates sculptured pteromorphae, they are smooth, at least dorsally (laterally), the veining being on the ventral (mesal) face or internal. I am unable to see clearly the notch but it appears to resemble that of Zetes. Notogaster with rather long, oblique pseudofissurae below normal position of mesonotal porose areas. Gular bristles fairly long (figure 19), sternal bristles represented by small punctures and possibly fine, short bristles; genital aperture slightly undulate on anterior and posterior edges, sides nearly parallel; anterior edge of covers seem to bear fine concentroconchoidal sculpturing; the two pairs of marginal bristles more or less hidden by this sculp-

turing; bristles 1 fairly distant from anterior margin, equidistant from lateral and median edges, bristles 4 on posterior margin, near median edge (figure 19), bristles 2 and 3 successively more mesad and subequally spaced with bristles 1, greatest space between bristles 3 and 4; parasternal bristles as in Zetes; paramesal bristles distant the diameter of a genital cover from aperture; anal aperture with sides strongly converging, anterior corner nicely rounded, posterior edge quite arcuate, anterior cover bristles (figure 18) close to anterior edge, nearer lateral than median edge, posterior bristles more approximate than anterior bristles; pseudofissurae quite long, at center of sides of aperture, not parallel to it; paranal bristles on transverse plane passing just anterior to anterior end of pseudofissurae; lateral pair of postanal bristles more remote than diameter of sides, the four postanals subequally spaced, that is the mesal pair more remote than posterior cover bristles.

Dimensions: "Length 0.56 mm.; breadth 0.43 mm."; length of genital cover (of female) 82, breadth 35 microns; length of anal cover 119, breadth 131 microns.

Holotype: Under bark of a tree standing in the water, at the mouth of Spoon River, Havana, Illinois; taken August 9th 1908 by Hart and Ewing (Ewing coll.).

KEY TO SPECIES

1. Lamellae developed as slight raised ridges, especially along distal ends, terminating about halfway to rostrum 2

1. Lamellae reduced to bands or straps closely appressed to cephaloprothorax, curving ventroposteriad to meet tectopedia II 7

2. Pteromorphae emarginate neither along ventral or anterior edges, gracefully undulate and rounded ..... PROTOKALUMMA 3

2. Pteromorphae emarginate along anterior edge so as to form a tooth on the outline; anterior end of notogaster colorless ..... *Parakalumma robustum*

3. Lamellar bristles inserted on transverse arm of lamellae, that is, on dorsal face of cephaloprothorax 4

3. Lamellar bristles inserted at distal end of lamellae, that is on dorsolateral edge of cephaloprothorax 6

4. Pseudofissurae of notogaster parallel to transverse plane, Columbia, Missouri ..... *Protokalumma fissuratum*

4. Pseudofissurae of notogaster diagonal 5

5. Distal end of head of pseudostigmatic organs rounded, broadly separating two distal bristles; bristles of genital covers much closer to lateral edge of covers than to median edge; postanal bristles reaching well beyond posterior edge of abdomen, with distal end strongly curved. ..... *Protokalumma depressum*

5. Distal end of head of pseudostigmatic organs tapering so as to bear two contiguous bristles at its apex; bristles of genital covers closer to median edge of covers than to lateral edge; postanal bristles not extending beyond posterior edge of abdomen, straight and stiff. ..... *Protokalumma pterotum*

6. Anterior edge of pteromorphae rounded; head of pseudostigmatic organs not bent at juncture with pedicel; adaler porose areas (as seen in dorsal aspect) longer (on transverse plane) than broad ..... *Protokalumma salicis*

6. Anterior edge of pteromorphae pointed (not toothed); head of pseudostigmatic organs bent at juncture with pedicel; adalar porose areas wider than long ..... *Protokalumma corticis*

7. Pteromorphae without decided emarginations, gracefully undulate along ventral edge, at most 8

7. Pteromorphae with a right angled notch cut into ventral edge 9

8. Pteromorphae without pale transverse groove running across their middle; postanal bristles extending far beyond abdomen *Neoribates quadrisetosus*

8. Pteromorphae with pale transverse groove running across their center ..... Genera HOLOZETES and HOLOKALUMMA

9. Pteromorphae without transverse groove; lamellar bristles frontal; sternal bristle punctures present ..... *Neorizetes rugosala*

9. Pteromorphae with transverse groove ..... ZETES and GALUMNA

LITERATURE CITED

1. *Banks, Nathan,* 1895 (Jan.), On the Oribatoidea of the United States, Trans. Am. Ent. Soc., vol. 22, pp. 1-16.

2. ..... 1910 (Jan.), New American Mites, Proc. Ent. Soc. Washington, vol. 12, pp. 2-12, pls. 1-3.

3. *Berlese, Antonio,* 1908 (Aug. 5), Elenco di Generi e Specie nuovi di Acari, Redia, vol. 5, pp. 1-15.

4. ..... 1910 (July 8), Brevi Diagnosi di Generi e Specie nuovi di Acari, Redia, vol. 6, pp. 346-388.

5. ..... 1914 (Dec. 31), Acari nuovi, Manipulus IX; Redia, vol. 10, pp. 113-150, pls. 1-4.

6. *Ewing, Henry Ellsworth,* 1909 (Oct. 8), New American Oribatoidea, Jour. N. Y. Ent. Soc., vol. 17, pp. 116-136, pls. 2-6.

7. ..... 1910 (March 1), A Systematic and Biological Study of the Acarina of Illinois, The University Studies, vol. 3 as part of the University of Illinois Bulletin, vol. 7, No. 14, 120 pp., 8 pls., 6 txt. figs.

8. ..... 1913 (May 31), New Acarina, Part I; Bull. Am. Mus. Nat. Hist., vol. 32, pp. 93-121, pls. 7-8, 9 txt. figs.

9. ..... 1917 (Jan. 27), New Acarina, Part II; Bull. Am. Mus. Nat. Hist., vol. 37, pp. 149-172, pls. 1-4.

10. *Heyden, Carl Heinrich Georges,* 1825 (Sept. 19), Versuch einer systematischen Eintheilung der Acariden, Isis von Oken, vol. 18 (1826), col. 608-613.

11. *Jacot, A. P.,* 1923, Oribatoidea Sinensis II, Jour. North China Branch Royal Asiatic Soc., vol. 54, pp. 168-181, 26 txt. figs.

12. ..... 1925 (May-June), Phylogeny in the Oribatoidea, Am. Nat., vol. 59, pp. 272-279.

13. ..... 1929 (Jan.), American Oribatid Mites of the Subfamily Galumninae, Bull. Mus. Comparative Zool., vol. 69, pp. 3-37, pls. 1-6, 1 txt. fig.

14. *Oudemans, Anthonie Cornelis,* 1919 (June), Notizen über Acari, 26 Reihe (Oribatidea, Gruppe der Galumnae), Archiv für Naturg., vol. 83, abt.A, heft 4, pp. 1-84, 114 txt. figs.

15. *Weiss, Harry Bischoff,* 1916 (March), Additional Records of New Jersey Acarina, Ent. News, vol. 27, pp. 109-110.

PLATE XIII.

Protokalumma depressa (1, p. 7), adult.

Fig.

1. Dorso/ventral aspects, legs and mouth parts omitted; ratio x120.
2. Pseudostigmatic organ; free hand.
3. Area about pseudostigma, dorsolateral aspect; the broken line above the wing hinge is the lower edge of the notogaster, the one above that is the upper edge of the ventral plate; interlamellar bristle foreshortened; ratio x200.
4. Lateral aspect showing legs drawn up into cupboards under the wing; leg I (except femur) omitted; the deeper structures dotted in; notogaster drawn down to its maximum extent; ratio x120.
5. Legs I, lateral aspect; ratio x200.
6. Legs II, lateral aspect; ratio x200.
7. Legs III, lateral aspect; ratio x200.
8. Legs IV, lateral aspect; ratio x200.
9. Palps and surrounding structures, ventrolateral aspect; ratio x264.
10. Diagrammatic sections of frons (of cephaloprothorax) to show difference between escarpment across face of cephaloprothorax (left side of numeral) and translamella (right side).

Protokalumma pterota (2, p. 8), adult

11. Pseudostigmatic organ; ratio x440.
12. Dorso/ventral aspects, legs and mouth parts omitted; ratio x120.

PLATE XIII.

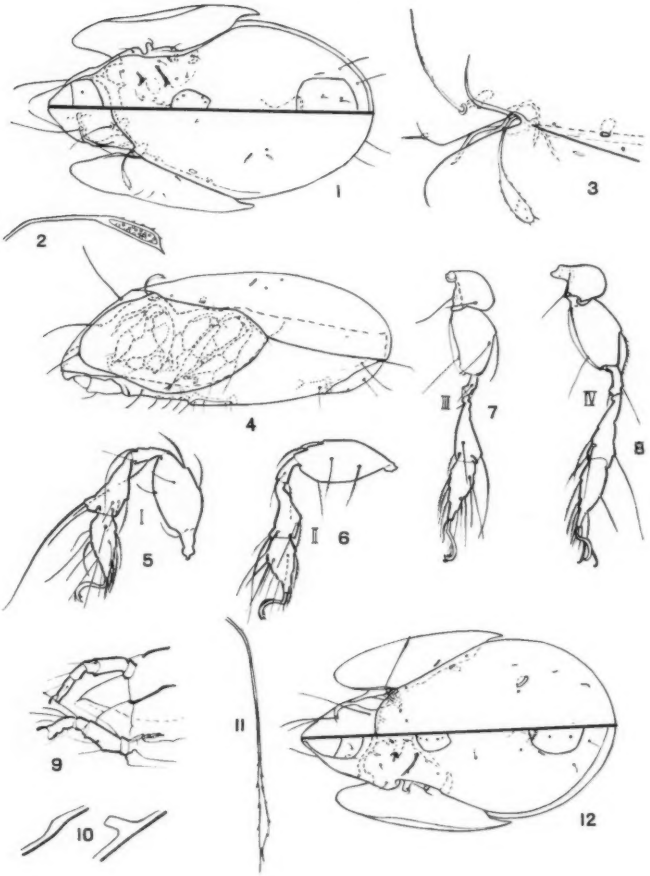


PLATE XIV.

Protokalumma corticis (8, p. 117), adult

Fig.
13. Pseudostigmatic organ; ratio x200.
14. Dorso/ventral aspects, legs and mouth parts omitted; ratio x100.

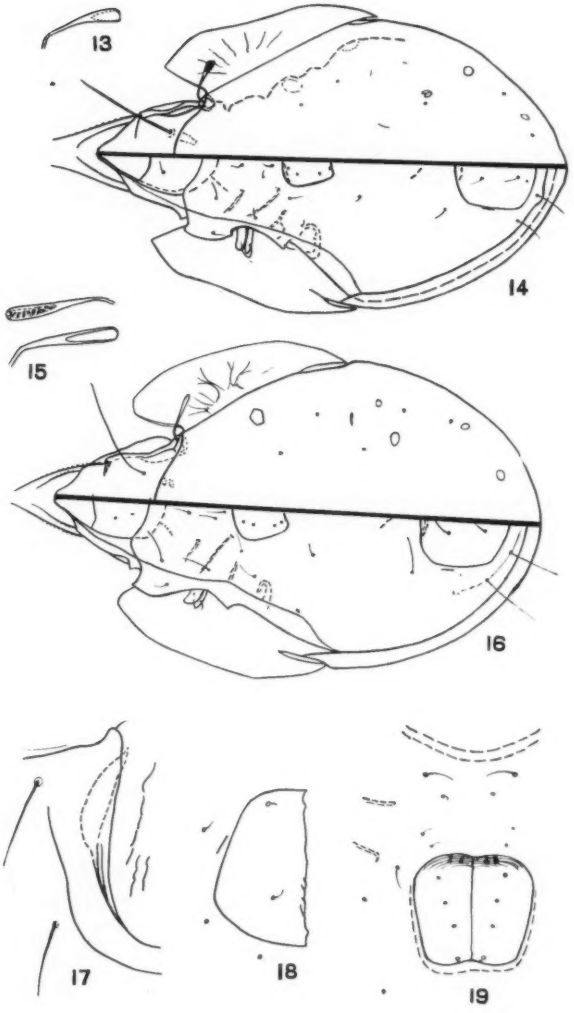
Protokalumma salicis (8, p. 117), adult

15. Pseudostigmatic organ; ratio x200.
16. Dorso/ventral aspects, legs and mouth parts omitted; ratio x100.

Neorizetes rugosala comb. nov., adult

17. Region of lamella and tectopedia I, including anterior end of a pteromorpha; ratio x200.
18. Region of anal aperture; ratio x200.
19. Region of genital aperture; ratio x200.

PLATE XIV.



WOUND HEALING IN SUBMERGED PLANTS *

ESTHER A. RODGER

INTRODUCTION

The fact that land plants respond to wounding by the formation of cambial tissue has been established for some time. The general impression with regard to submerged plants is that they do not have this ability, but that they react by a dying-out of the injured part. This investigation was made in an attempt to find to what extent this is true.

HISTORICAL

There is very little literature that concerns wound-healing in submerged plants, although since the latter part of the nineteenth century it has been known to exist in mesophytes.

Massart (2), who studied cicatrization in plants in detail, stated that periderm was not formed in wounded plants which were in a moist atmosphere.

Priestly and Woffenden (3) reported the general absence of periderm in the axes of water plants and the cortices of roots.

Haberlandt (1) found that wounds in kohl-rabi which had been washed with water did not produce periderm, while those which had not been washed did produce it. Wounds which were first washed and then covered with macerated kohl-rabi were found to produce a more extensive periderm than the unwashed wounds.

The work of Buscalioni and Muscatello, and that of Woit were cited by Wylie (4) in a recent paper. Wound responses were found by Buscalioni and Muscatello to be influenced by humidity and light. Response was more active in dicotyledons

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than in monocotyledons or pteridophytes. In working on wounded leaves, Woit found that the response was slight in places where water loss was greatly lessened. He observed that callus was formed in a moist atmosphere, while a freely exposed surface formed wound cork only.

Wyle (4, 5) reported the excessive moisture or rigidity of wounded tissues prevented pseudocicatrice formation, and put off temporarily or wholly the formation of true cicatrice.

METHODS

Bog and aquatic representatives of fifteen dicotyledonous and of nine monocotyledonous families were studied. Whenever possible, plants were collected which were already wounded. Those which had no wounds were kept out doors in a container in a place where they were in the sunlight about five hours a day. Cuts were made with a scalpel in different parts of the plants, and the wounded parts were kept submerged in lake water. After two weeks, segments were removed from parts of the plants in which comparison could be made of the wounded and normal tissue.

The methods of studying artificially and naturally wounded plant parts were the same. Stems that were firm enough were sectioned on a sliding microtome and stained in the usual way. Delicate parts were killed, fixed, run through ethyl and butyl alcohols, imbedded in paraffin, cut, and stained.

DATA

MONOCOTYLEDONEAE

Studies were made on *Typha latifolia*, *Potamogeton natans*, *Sagittaria latifolia*, *Triglochin maritima*, *Vallisneria spiralis*, *Dulichium arundinaceum*, *Scirpus americanus*, *Scirpus validus*, *Acorus calamus*, *Calla palustris*, *Iris versicolor*, and *Habenaria blepharoglottis*. No periderm formed around the wounds of any of these. Leaf blades, leaf petioles, stems, and rhizomes were wounded without showing any response. Large areas of cells around the wounds collapsed and died. Often the death of the whole organ, in which the wound had been made, resulted.

In *Potamogeton praelongus* the cells near wounds showed notable thickening and were suberized. Cells near wounded areas in *Maianthemum canadense,* also were suberized. This effect extended to the cross walls of the epidermal cells.

DICOTYLEDONEAE

1. Salicaceae

   Salix lucida leaf showed pseudocicatrice and periderm, with its cells divided parallel to the wound.

2. Polygonaceae

   Polygonum amphibium leaf had pseudocicatrice and both vertical and horizontal divisions in the periderm cells. *Rumex crispus* leaf pseudocicatrice was thin and the cell divisions in the cicatrice were parallel to the wound.

3. Nymphaeaceae

   Castalia odorata leaf did not have pseudocicatrice, but cells of the palisade and spongy layers were divided to fill in the air spaces near the cut. Petal cells did not form periderm. The leaf and petiole of *Nymphaea americana* formed no periderm, but parenchyma cell walls of the root became thickened on the side nearest the wound, and divided parallel to it to fill in the air spaces. The rhizome showed distinct periderm, with cell division in two planes. (Fig. 1 & 3.)

4. Ranunculaceae

   The root of *Caltha palustris* examined showed periderm, but there was no indication of it in the leaf.

5. Cruciferae

   An aerial leaf of *Radicula aquatica* formed a distinct pseudocicatrice and cicatrice, when wounded and submerged, with the divisions nearest the wound parallel to it, and those farther back at right angles to it. (Fig. 2.)

6. Sarraceniaceae

   Sarracenia purpurea leaf showed periderm.

7. Rosaceae

   Leaves of *Fragaria virginiana, Geum rivale, Potentilla*

anserina, P. palustris, and *Rubus triflorus* showed cell collapse at places of wounding. A petiole of *Potentilla anserina* formed periderm, while in a stem of *P. palustris* pith and cortical cells became meristematic.

8. Violaceae
Viola sp. *(cucullata?)* leaf tissues collapsed.

9. Onagraceae
Epilobium adenocaulon leaf showed no periderm.

10. Ericaceae
Periderm was observed in the stem of *Chamaedaphne calyculata,* and in the leaf and stem of *Pyrola asarifolia.* In the first, the wound extended to the xlyem. A new cambium formed across the wounded xylem. Cell walls of the new wood were thicker than normal, and the vessels were filled with tyloses. The reaction was like that of woody tissues not submerged. The pseudocicatrice in *Pyrola* was very thick.

11. Primulaceae
The leaf, aerial, and submerged stem of *Lysimachia thyrsiflora* were studied. Periderm was found in all layers of the leaf, with the most rapid division in the spongy layer. Cell division in the stems helped to fill in the air spaces. In the submerged part of the stem single cell rows which had separated the air spaces had divided to form as many as six rows. (Fig. 4.)

12. Asclepiadaceae
Asclepias incarnata stem showed periderm in the intraepidermal layers.

13. Labiatae
Prunella vulgaris leaf tissue collapsed around the wound.

14. Scrophulariaceae
Mimulus glabratus, var. *fremontii* leaf tissues rotted. The leaf and stem sections of *Veronica americana* formed periderm. No evidence of it was seen in the stem sections until the twelfth day after wounding. Cell suberization was first noted after nineteen days.

15. Compositae
Aster sp. leaf cells collapsed. *Eupatorium perfoliatum* leaf reacted in the same way. The stem of *Eupatorium purpureum* showed periderm development in the wounded parenchyma cells, but not in the collenchyma. The cortical cells were divided to fill in the large air spaces in a stem of *Solidago canadensis.*

DISCUSSION

MONOCOTYLEDONEAE

Of the plant parts of the fourteen monocotyledons studied, none formed periderm as a response to wounding. A rotting-away of the cut tissues was found to be present in at least one part of each of these plants.

In two cases thick-walled cells were found adjacent to the wound. There the thickening of the cell walls may have been the means the plants had for protecting the other parts from further extension of the original wound. In this case, the injury was not a cut, but a crushing of the cortical cells. The leaf of *Maianthemum canadense,* thirteen days after having been wounded, showed distinct suberization of cell walls near the cut.

The rotting away of an injured rootstock, accompanied by the appearance of a new shoot, was a reaction which might have been expected from an aquatic whose rootstock was as parenchymatous as that of *Sagittaria latifolia,* in which this was observed.

DICOTYLEDONEAE

With the exception of the stem of *Chamaedaphne* and the leaf of *Salix lucida,* all of the dicotyledons observed were herbaceous.

As one might have anticipated in water plants, cell collapse following wounding was slight, since water loss was not great. Many of the plants studied showed little or no cicatrice, contrary to the habit of land plants, as noted by Wylie. Pseudocicatrice formation is often due to the drying-out and collapsing of cells. There would be no opportunity for this drying in submerged plants, which makes it the more surprising

that pseudocicatrice was present in some of them (for example, *Radicula aquatica*).

A comparison of the wounded and submerged stems of *Lysimachia thyrsiflora* showed that the response to wounding was practically the same under either condition. The outer cells, somewhat swollen, divided first parallel to the wound. This division produced cells which were smaller than the parent cell, less rounded, and more compactly arranged. While Wylie found that cicatrice, with thickened and suberized walls, took from ten to twelve days to form in mesophytes, the writer found, on observing sections of submerged plants thirteen days after wounding, that cicatrice had just begun to form, and there was usually no trace of suberization.

It was noted that division in leaves took place more rapidly in the spongy than in the palisade layer. Division in epidermal cells was found only in the leaf of *Lysimachia thyrsiflora*.

In wounded stems, roots, and petioles, the pith and cortical cells when exposed, became meristematic and divided to form cells to fill in the air spaces. No change was observed in the phloem or cambium regions.

Of the twenty-six plants of which wounded parts were studied, seventeen responded to cutting by the formation of periderm. Of these there were typical aquatics, such as *Castalia odorata* leaf and *Nymphaea americana* rhizome and root, and semi-aquatics, such as *Polygonum amphibium* leaf. For five of the nine plants in which no periderm was found, the time which had elapsed since wounding had taken place was unknown. That the other four would have done nothing but collapse near the wound, had a longer time elapsed before observation, is uncertain. It was observed that in all the *Veronica americana* stem sections but one, there was no sign of periderm until the sixteenth day. Suberization of cells was first seen the nineteenth day after wounding, a response which is much slower than that in land plants.

Massart and Woit found that periderm did not form in wounded parts of plants which were kept in a damp atmosphere. Woit stated that callus only was formed. In the pres-

ent study, wounds were not subjected to a damp atmosphere, but were submerged. Callus did not form.

Haberlandt's results with kohl-rabi indicated that wounds which had been washed with water did not form periderm. It was his belief that a wound hormone, which was carried away by the water, was formed by the injured cells. The results secured by the writer indicate either that no wound hormone was formed in the plants studied, or that it was not dissolved by the water which surrounded the submerged wounds.

The observations of Priestly and Woffenden that periderm was not to be found in the roots or in the axes of aquatic plants have not been verified by this study. While preliminary suberization in aerial stems may depend, as they maintain, on the presence of air, periderm formation in submerged plants seems not to require air.

The growth of a plant in an aquatic habitat apparently does not prevent its reacting to wounding by the formation of the periderm that is characteristic of land plants.

SUMMARY

1. Plants whose wounded parts were submerged in water were found to respond to wounding in one of the following ways:
   a. By a rotting away of the affected part, accompanied in some cases (as in rootstocks) by a development of a new shoot at the growing point.
   b. By an obvious thickening of the cell walls near the wound, this change being unaccompanied by the formation of any meristematic tissue.
   c. By the formation, from cells which are full grown, of meristematic cells that divide to fill in the air spaces near the wound with parenchymatous cells.
2. Pseudocicatrice formation does not always precede the formation of periderm, although it may be present.
3. Cell division in the periderm seems usually to involve only the intraepidermal layers.
4. Periderm is formed less rapidly in submerged plants than

in others, the time of initiation there being about the time of completion in land plants.

5. Of the fourteen monocotyledonous plants studied, none formed periderm as a response to wounding.

6. Seventeen of the twenty-six dicotyledonous plants observed formed periderm in at least one aprt as a response to wounding.

7. The formation of periderm in one part of a wounded plant does not necessarily mean that it is to be expected as a reaction throughout the plant.

8. The occurrence of periderm in wounded areas, while not common to all submerged plants, is not unusual as a wound reaction.

LITERATURE CITED

1. *Haberlandt, G.* Über Zellteilungshormone und ihre Beziehungen zur Wundheilung, Befruchtung, Parthenogenesis und Adventivembryonie. Biol. Centralbl. 42: 145-172, 1922.

2. *Massart, J.* La Cicatrisation chez les végétaux. Mem. Couronnes Acad. Roy. Belgique 57:2-68, 1898.

3. *Priestly, J. H.* and *Woffenden,* L. M. Physiological studies in plant anatomy V. Causal factors in cork formation. New Phytologist 21:252-268, 1922.

4. *Wylie, R. B.* Cicatrization of foliage leaves. I. Wound responses of certain mesophytic leaves. Bot. Gaz. 90:260-278, 1930.

5. ———— Cicatrization of foliage leaves, II. Wound responses of certain broad-leaved evergreens. Bot. Gaz. 92: 279-295, 1931.

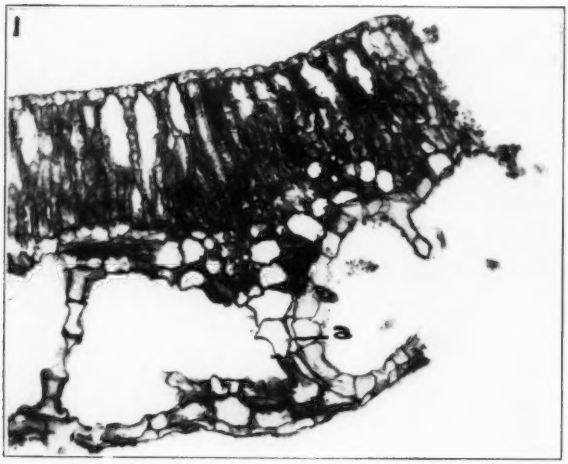

Fig. 1.

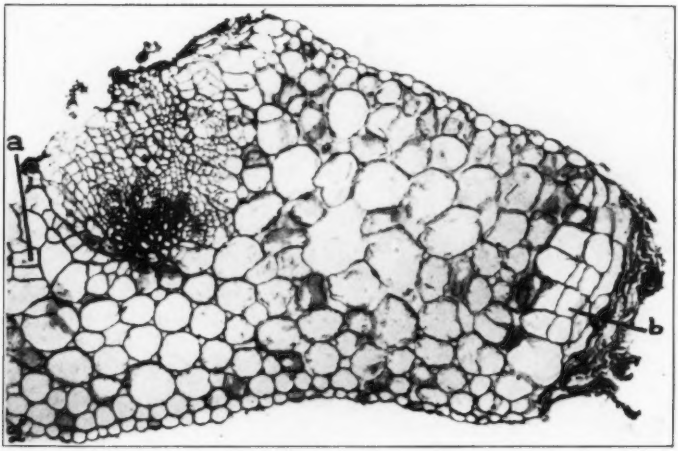

Fig. 2.

Fig. 1, transverse section of leaf of *Castalia odorata*. Periderm formation shown in spongy mesophyll (a). Fig 2, transverse section of leaf of *Radicula aquatica*, showing periderm in the region of a vein (a), and in the intra-epidermal layers, adjoining the wound (b).

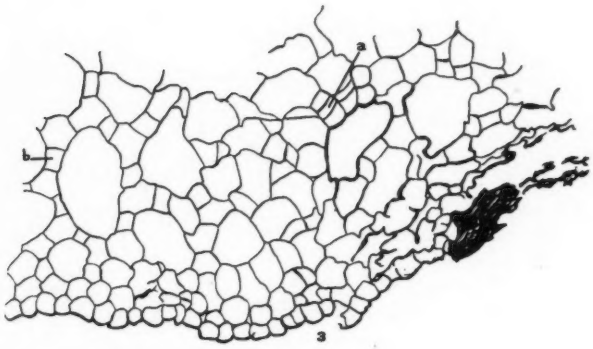

Fig. 3 Transverse section of a root of *Nymphaea americana*, showing the filling in of air spaces with cells originating from wound periderm (a). Normal tissue (b).

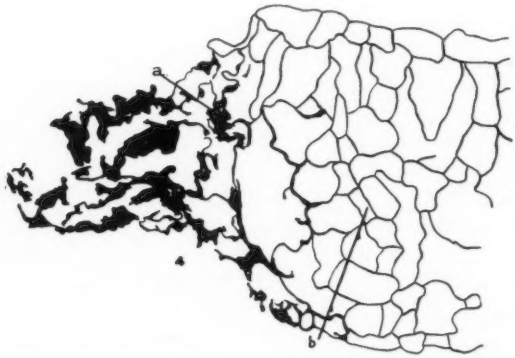

Fig. 4. Transverse section of a leaf of *Lysimachia thyrsiflora*, showing pseudocicatrice (a), and periderm (b) in the area next the wound.

STUDIES OF ARKANSAS FUNGI *

I. Basidiomycetes.

DELBERT SWARTZ

The flora of the Arkansas Ozarks has long been a subject of great interest to botanists. The writer has had the opportunity to study the fungi of this region during the years 1929-1933. It is hoped that the following list of Basidiomycetes collected during that time may prove of interest to mycologists and to botanists in general, and be a contribution to a more complete knowledge of the flora of that region.

Agaricaceae

1. *Tricholoma personatum* Fr. This species is somewhat smaller than the northern form and occurs less frequently.
2. *Tricholoma nudum* Fr. On ground in oak woods.
3. *Tricholoma sejunctum* Fr. On ground in oak woods.
4. *Amanita muscaria* Fr. Our forms are intermediate in color between the northern form and the western form. Frequent.
5. *Amanita phalloides* Fr. Our form ordinarily is in the smaller sizes. Frequent locally.
6. *Amanita rubescens* Fr. In pastured oak woods.
7. *Clitocybe ochropurpurea* Berk. On bare ground in frondose woods.
8. *Clitocybe laccata* Fr. This species is not so common as in its northern range.
9. *Clitocybe illudens* Schw. Ozark National Forest. Not common in northwestern part of the state. I have had more reports of it from the southern part of the state.
10. *Clitocybe infundibuliformis* Fr. Common.
11. *Clitocybe dealbata* Fr.

* Research paper, Journal series, University of Arkansas No. 327.

12. *Armillaria mellea* Fr. Extremely abundant in certain places, especially in semi-open places in the White River valley. Not of such general occurrence on the hillsides in the northwestern part of the state.
13. *Marasmius oreades* Fr. Common.
14. *Marasmius rotula* Fr. Very common.
15. *Marasmius siccus* (Schw.) Fr.
16. *Marasmius epiphyllus* Fr. On fallen oak leaves, attached to midrib and veins.
17. *Marasmius capillaris* Morg. On fallen oak leaves.
18. *Marasmius resinosus* (Pk.) Sacc. On grass and leaves in oak woods.
19. *Marasmius fagineus* Morg. On bark of living elm.
20. *Hygrophorus peckii* Atk. Rare. I have collected this species but once.
21. *Hygrophorus Russula* Fr. This edible form is not of general occurrence in the northwestern part of the state, but is more common southward.
22. *Hygrophorus chlorophanus* Fr.
23. *Hygrophorus psitticinus* Fr.
24. *Hygrophorus eburneus* Fr.
25. *Cantherellus cibarius* Fr.
26. *Cantherellus cinnabarinus* Schw.
27. *Lactarius volemus* Fr.
28. *Lactarius piperatus* Fr.
29. *Lactarius pyrogalus* Fr.
30. *Lactarius insulsus* Fr.
31. *Lactarius indigo* Schw. Rare.
32. *Lactarius hygrophoroides* B. & C.
33. *Russula adusta* Fr.
34. *Russula mariae* Pk.
35. *Russula squalida* Pk.
36. *Russula emetica* Fr.
37. *Pleurotus ulmarius* Fr. On elm tree on campus of University of Arkansas, Fayetteville.
38. *Pleurotus ostreatus* Fr. Common.
39. *Pleurotus lignatilis* Fr. Ozark National Forest.
40. *Pleurotus porrigens* Fr. On decaying *Pinus echinata* in Ozark National Forest.

41. *Schizophyllum commune* Fr. Especially common in our frondose woods.
42. *Panus strigosus* B. & C. Ozark National Forest.
43. *Panus rudis* Fr. Very common in frondose woods.
44. *Lentinus tigrinus* Fr. On oak log near Marshall, Arkansas.
45. *Lentinus lepideus* Fr. Common in northwestern part of the state.
46. *Lentinus vulpinus* Fr. One collection near Lurton, Arkansas in the Ozark National Forest.
47. *Amanitopsis volvata* Pk.
48. *Amanitopsis vaginata* Fr.
49. *Lepiota clypeolaria* Fr.
50. *Lepiota cepaestipes* Fr. On sawdust.
51. *Lepiota procera* Fr. In pastural clearing.
52. *Lepiota naucina* Fr. Along trail Mt. Sequoyah.
53. *Collybia dryophila* Fr.
54. *Collybia hygrophoroides* Pk.
55. *Collybia abundans* Pk.
56. *Collybia radicata* Fr. This species is very abundant in the hills in the northwestern part of the state. Sometimes the pileus is a bright yellow on top.
57. *Collybia longipes* Fr.
58. *Collybia velutipes* Fr.
59. *Mycena haematopa* Fr.
60. *Mycena galericulata* Fr.
61. *Mycena vulgaris* Fr.
62. *Mycena pura* Fr.
63. *Mycena alcalina* Fr.
64. *Omphalia campanella* Fr.
65. *Omphalia fibula* Fr.
66. *Coprinus atramentarius* Fr.
67. *Coprinus comatus* Fr.
68. *Coprinus micaceus* Fr.
69. *Coprinus sterquilinus* Fr.
70. *Coprinus fimetarius* Fr.
71. *Coprinus radians* (Desm.) Fr.
72. *Coprinus bulbilosus* Pat.
73. *Coprinus sclerotigenus* E. & E.

74. *Panaeolus solidipes* Pk.
75. *Panaeolus retirugis* Fr.
76. *Psathyrella disseminata* Fr.
77. *Stropharia semiglobata* Fr.
78. *Stropharia stercoraria* Fr.
79. *Psalliota rodmani* Pk. This species was very abundant on the campus of the University of Arkansas during May-June, 1933.
80. *Psalliota subrufescens* Pk. In a flower box on the writer's porch.
81. *Psalliota campestris* Fr.
82. *Psalliota haemorrhodaria* Fr.
83. *Psathyra umbonata* Pk.
84. *Psilocybe merdaria* Fr.
85. *Psilocybe foenisecii* Fr.
86. *Hypholoma sublateritium* Fr.
87. *Hypholoma velutinum* (Fr.) Quel.
88. *Claudopus nidulans* Fr.
89. *Volvaria speciosa* Fr.
90. *Volvaria pusilla* Fr.
91. *Pluteus cervinus* Fr.
92. *Entoloma griseum* Pk.
93. *Galera bulbifera* Kauff.
94. *Hebeloma pascuense* Pk.
95. *Pholiota praecox* Fr.
96. *Pholiota squarrosoides* Pk.
97. *Pholiota adiposa* Fr.
98. *Cortinarius alboviolaceus* Fr.
99. *Cortinarius annulatus* Pk.
100. *Cortinarius rubripes* Kauff.
101. *Inocybe radiata* Pk.
102. *Naucoria lignicola* Pk.

Polyporaceae

1. *Polystictus versicolor* Fr.
2. *Polystictus hirsutus* Fr.
3. *Polyporus sulfureus* Fr.
4. *Polyporus Schweinitzii* Fr.
5. *Polyporus picipes* Fr.
6. *Polyporus frondosus* Fr.

7. *Polyporus squamosus* Fr.
8. *Polyporus elegans* Fr.
9. *Polyporus brumalis* Fr.
10. *Polyporus fumosus* Fr.
11. *Polystictus pergamenus* Fr.
12. *Polyporus lucidus* Fr.
13. *Polyporus gilvus* Fr.
14. *Fomes applanatus* Fr.
15. *Fomes igniarius* Fr.
16. *Fomes Everhartii* E. & E.
17. *Fomes fraxineus* Fr.
18. *Fomes connatus* Fr.
19. *Fomes fraxinophilus* Pk.
20. *Fomes roseus* Fr.
21. *Fomes conchatus* Fr.
22. *Trametes pini* Fr.
23. *Trametes cinnabarinus* Fr.
24. *Favolus canadensis* Klotzsch.
25. *Favolus europeus* Fr.
26. *Daedalea unicolor* Bull. ex Fr.
27. *Daedalea ambigua* Berk.
28. *Daedalea confragosa* Bolton ex Fr.
29. *Lenzites saepiaria* Fr.
30. *Merulius lacrymans* Fr.
31. *Polyporus adustus* Fr.
32. *Polyporus dryadeus* Fr.

Hydnaceae

1. *Hydnum repandum* L.
2. *Hydnum erinaceum* Bull.
3. *Hydnum caput-ursi* Fr.

Thelephoraceae

1. *Thelephora terrestris* (Ehren.) Fr.
2. *Stereum lobatum* Fr.
3. *Stereum hirsutum* Fr.
4. *Stereum versicolor* Fr.
5. *Stereum Murrayi* Fr.
6. *Stereum frustulosum* (Pers.) Fr.
7. *Hymenochaeta tabacina* Lev.
8. *Craterellus cantherellus* (Schw.) Fr.

Lycoperdaceae

1. *Lycoperdon gemmatum* Batsch.
2. *Lycoperdon pyriforme* (Schaeff.) Pers.
3. *Lycoperdon pulcherrimum* B. & C.
4. *Lycoperdon echinatum* Pers.
5. *Lycoperdon Wrightii* B. & C.
6. *Lycoperdon atropurpureum* Vitt.
7. *Lycoperdon glabellum* Pk.
8. *Lycoperdon muscorum* Morg.
9. *Lycoperdon cruciatum* Rostk.
10. *Calvatia caelata* (Bull.) Morg.
11. *Calvatia saccata* (Fr.) Lloyd.
12. *Calvatia cyathiformis* (Bosc.) Morg.
13. *Calvatia rubro-flava* (Cragin) Lloyd.
14. *Bovista pila* B. &. C.
15. *Bovista plumbea* Pers.
16. *Geaster rufescens* Pers.
17. *Geaster triplex* Jung.
18. *Geaster saccatus* Fr.
19. *Disciseda candida* (Schw.) Lloyd.

Sclerodermataceae

1. *Scleroderma vulgare* Fr.
2. *Scleroderma verrucosum* (Bull.) Pers.
3. *Scleroderma cepa* (Vaill.) Pers.

Nidulariaceae

1. *Crucibulum vulgare* Tul.
2. *Cyathus striatus* Willd.

Phallaceae

1. *Dictyophora duplicata* (Bosc.) E. Fischer.
2. *Ithyphallus Ravenelii* (B. & C.) E. Fischer.
3. *Mutinus caninus*
4. *Mutinus bovinus* } *M. elegans* sensu Lloyd.

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AMBROSIA BIDENTATA MICHX. × A. TRIFIDA L.

KENNETH LESTER JONES

The hybrid, *Ambrosia bidentata* × *A. trifida*, was first reported by Asa Gray (2) in 1856, as follows: "A hybrid from these parents has been sent to us by Mr. Eggert of St. Louis. This district is famous for hybrids, Dr. Engelmann having detected so many there, but this one, we believe is new." Rydberg (3) states that Eggert collected the plants at St. Clair, Illinois. O. C. Durham also found the hybrid at Harrisonville, Missouri in 1927, and generously furnished the writer with herbarium specimens. A hybrid Ambrosia of different parentage from the foregoing, viz., "*Ambrosia trifida* L., and *Ambrosia artemisiifolia* L.," has been reported by Wylie (4).

Two plants of *A. bidentata* were grown in my Ambrosia cultures at the University of Michigan Botanical Gardens in 1931. The seeds, from which these plants developed, were collected in Arkansas by Dr. Delbert Swartz. This species does not occur in Michigan. One plant was open-pollinated to maintain the species; the other was used as a female parent in the cross with *A. trifida*, of local origin. Only one seed was secured from the cross.

The seed was after-ripened for two months at 5° C. Davis (1) found this treatment necessary in germinating A. trifida seeds. The hybrid was grown in 1932, and an individual essentially identical to it occurred in the progeny of the open-pollinated plant of *A. bidentata*. The parental species and the hybrid are illustrated in Plates 1-3. A list of contrasting characteristics, and their inheritance in the hybrid, follow. All plants were grown in the greenhouse under similar conditions.

1. Height: (Fig. 4, 5, 6). *A bidentata;* average 4 dm. (Fig. 6). *A trifida;* average 8.5 dm. In Fig. 4 the plant is smaller than the average because most of the *A trifida* were dead before the hybrid was mature. Hybrid; 5 dm. and 6.2 dm. Intermediate.
2. Branching: (Fig. 4, 5, 6.) *A bidentata;* profusely

branched. *A. trifida;* unbranched. Hybrid; branched. Intermediate.

3. Leaf arrangement: (Fig. 4, 5, 6.) *A bidentata;* opposite below, alternate above. *A. trifida;* opposite. Hybrid; opposite below, alternate above. *A. bidentata* dominant.
4. Leaf shape: (Fig. 1, 2, 3.) *A. bidentata;* lanceolate, pair of large teeth at base of blade. (Fig. 3.) *A. trifida;* three-cleft, rhombic in outline, lobes ovate. (Fig. 1.) Hybrid; mostly three-cleft, lanceolate in outline, pair of teeth at base of blade. Intermediate. (Fig. 2.)
5. Leaf size: (Fig. 1, 2, 3.) *A bidentata;* 3 to 7 cm. long by 0.5 to 1 cm. wide. *A. trifida;* 10 to 18 cm. long by 5 to 11 cm. wide. Hybrid; 5.5 to 13 cm. long by 1.5 to 6 cm. wide. Intermediate.
6. Leaf attachment: (Fig. 4, 5, 6.) *A. bidentata;* sessile. *A. trifida;* petioled. Hybrid; sessile. *A. bidentata* dominant.
7. Leaf margin: (Fig. 1, 2, 3.) *A. bidentata;* entire but for pair of large teeth at base. *A. trifida;* serrate. Hybrid; serrate. *A. trifida* dominant.
8. Position of blade: *A. bidentata;* twisted. *A. trifida;* flat. Hybrid; flat. *A. trifida* dominant.
9. Nature of staminate inflorescence: (Fig. 7, 8, 9.) *A. bidentata;* spike. (Fig. 9.) *A. trifida;* raceme, pedicels over 1 mm. (Fig. 7.) Hybrid; raceme, pedicels less than 1 mm. Intermediate. (Fig. 8.)
10. Length of staminate inflorescence: (Fig. 7, 8, 9.) *A. bidentata;* 4 to 8.5 cm. *A. trifida;* 7 to 14 cm. Hybrid; 6 to 10 cm. Intermediate.
11. Staminate involucre: *A. bidentata;* very oblique, lobe farthest from rachis, long, lanceolate, and incurved. *A. trifida*; almost symmetrical, three outer lobes slightly elongated. Hybrid; oblique, three outer lobes considerably elongated. Intermediate.
12. Shape of staminate heads; *A. bidentata;* turbinate. *A. trifida;* saucer-shaped. Hybrid; turbinate. *A. bidentata* dominate.

13. Pubescence on staminate involucres: *A. bidentata;* long and dense. *A. trifida;* short and sparse. Hybrid; long and dense. *A. bidentata* dominant.
14. Color of veins of staminate involucres: *A. bidentata;* green. *A. trifida;* three main veins black, the others green. Hybrid; only the central vein black. Intermediate.
15. Color of angles of corolla: *A. bidentata;* colorless. *A. trifida;* black. Hybrid; black. *A. trifida* dominant.
16. Number of staminate flowers per head: (counts made from 50 heads in each instance.) *A. bidentata;* range 6 to 9, mean 6.8. *A. trifida;* range 9 to 27, mean 15.6. Hybrid: range 10 to 16, mean 12.7. Intermediate.

Chromosome studies of these plants and of numerous sex types of *A. elatior* have been made by the writer and these will be reported elsewhere. The haploid chromosome number of *A. trifida* is 12, and that of *A. bidentata* is 17. Chromosome counts from root tips of both hybrid plants showed the diploid number to be 29.

The hybrids were selfed and set no seed. An examination of 1,000 pollen grains, from random samples, revealed 71 per cent defective grains. The cross has been repeated using 16 plants of *A. bidentata* as female parents. Twenty-two seeds were secured, ten of which have germinated. An attempt will be made to cross these hybrids with the parental species.

The writer is indebted to Dr. W. C. Steere for making the photographs.

LITERATURE CITED

1. *Davis, W. E.*, Primary dormancy, after-ripening, and development of secondary dormancy in embryos of Ambrosia trifida. Amer. Jour. Bot. 17:58-77. 1930.
2. *Gray, A.*, Ambrosia bidentata × Ambrosia trifida. Bot. Gaz. 11:338. 1886.
3. *Rydberg, P. A.*, Carduales. North American Flora. 33:1-46. 1922.
4. *Wylie, R. B.*, A hybrid ragweed. Proc. Iowa Acad. of Science. 22:127-128. 1915.

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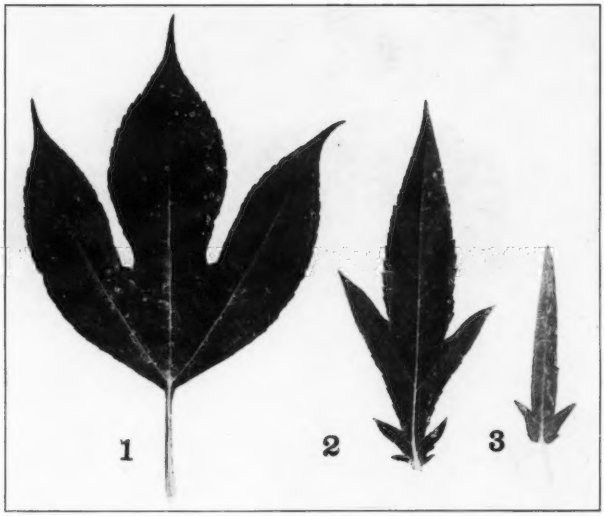

Fig. 1. Leaf of *A. trifida*. Fig. 2. Leaf of *A. bidentata*, × *A. trifida*. Fig. 3. Leaf of *A. bidentata*.

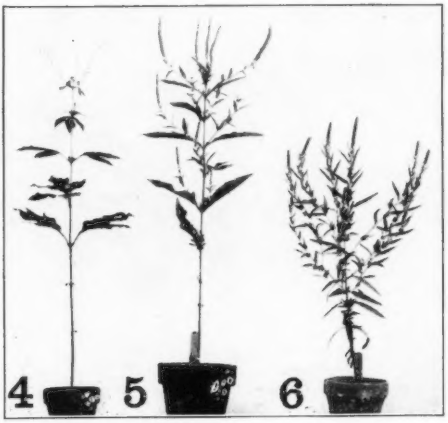

Fig. 4. *A. trifida*. This plant was smaller than the average but was the best specimen available when *A. bidentata* × *A. trifida* was mature.

Fig. 5. *A. bidentata* × *A. trifida*.

Fig. 6. *A. bidentata*.

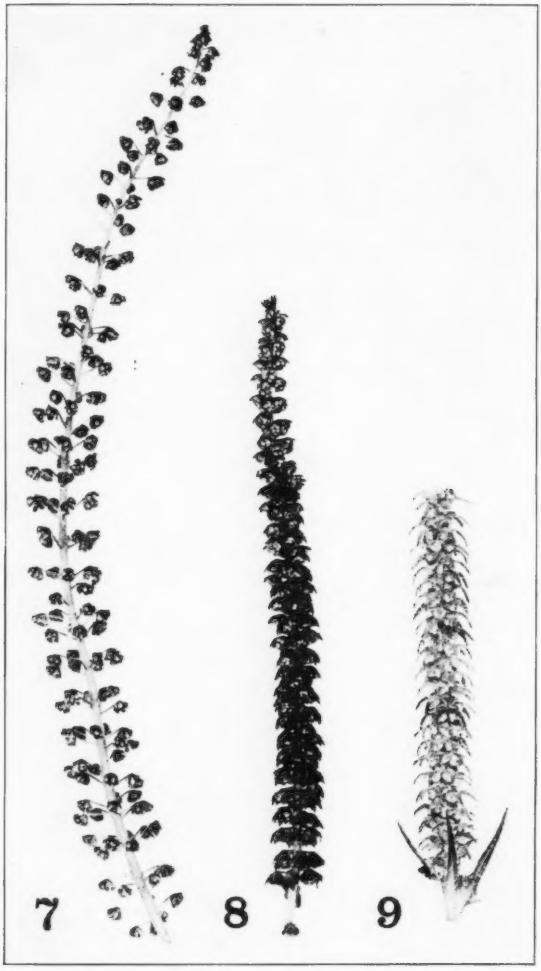

Fig. 7. Staminate inflorescence of *A. trifida.*
Fig. 8. Staminate inflorescence of *A. bidentata* × *A. trifida.*
Fig. 9. Staminate inflorescence of *A. bidentata.*

NOTES AND DISCUSSIONS

SCYTONEMA ALATUM (CARM.) BORZI IN OHIO

J. H. HOSKINS

This striking species of the genus *Scytonema* which is placed in the section PETALONEMA by some authors (1, 2, 6) based on the divergence of the lamellae of its thick sheath which terminate in prominent, wing-like expansions, the ocreae, is not uncommonly found on wet limestone rocks in Europe.

S. alatum was originally discovered by Capt. Carmichael on moist rocks in Great Britain about 1823, and figured and described by his friend Dr. R. K. Greville (3) the following year under the name *Oscillatoria alata* as suggested in Capt. Carmichael's communication to Greville commenting upon the plant.

According to Smith (7), however, *Scytonema alatum* has been reported from America but twice, by Harvey (4) in 1858 from limestone cliffs at Niagara Falls, and by Hone (5) in 1903 from a quiet stream near Minneapolis, Minnesota.

The writer is indebted to Mr. Wm. Bridge Cooke, a student at the University, for some excellent collections of *S. alatum* from the Seven Caves region of Highland County, Ohio. Here a stream known as Rocky Fork has cut a channel through Cedarville Dolomite at places to a depth of seventy-five feet or more. A considerable portion of the steep walls of the gorge is kept permanently moist by seepage, and on these moist rocks *S. alatum* occurs in quantity, usually with other species, forming a relatively thick layer over a considerable area.

S. alatum shows a rather strict localization to a limestone substratum, as is true of some other species of the genus. It is probable, as has been suggested (7), that this plant shows a high degree of specialization in relation to its habitat.

1. *Geitler, L.*,1925. Cyanophyceae, in Pascher, A., Süsswasserflora Deutschlands, Österreichs u. d. Schweiz. 12; 261.

2. ————1932. Cyanophyceae, in Rabenhorst, L., Kryptogamenflora v. Deutschland, Österreich u. d. Schweiz. 14: 788.

3. *Greville, R. K.*, 1828. Scot. Crypt. Flora IV: pl. 222 and text opposite.

4. *Harvey, W. H.*, 1858. Nereis Boreali-Americana. III: 98.

5. *Hone, D. S.*, 1903. Petalonema alatum in Minnesota. Minn. Bot. Studies 3: 47.

6. *Lemmermann, E.*, 1910. Algen I, in Kryptogamenflora der Mark Brandenburg. 3: 214.

7. *Smith, G. M.*, 1933. Fresh-water Algae of the United States. New York. pp. 94-95.

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A PTYCHOCARPUS TYPE OF FRUCTIFICATION FROM ILLINOIS

J. H. HOSKINS

Some years ago the writer found in a thin section cut from a Coal Measure petrifaction from Danville, Illinois, a fructification similar to *Ptychocarpus* Weiss. In mounting the section it was unfortunately broken and the part containing the fructification was lost.

From another petrifaction from the same horizon the writer recently has observed a similar fructification. Due to large amounts of opaque material in the section, it was not possible to use transmitted light. The following data are based on observations made with the Leitz "ultropaque" microscope.

The fructification consists of seven sporangia or loculi, which are attached to each other laterally and to a common central receptacle, and which are imbedded in a tissue which, in transverse section, entirely surrounds the sporangia. Each

sporangium has an individual wall, or tapetum, as Prof. Scott (2) suggests for the similar situation in *Ptychocarpus unitus* Brongn. A vascular bundle traverses the central receptacle.

The fructification has a diameter of approximately .6mm. The bundle traversing the central receptacle is composed of a small number of comparatively large and uniform tracheids. The receptacle as a whole has a diameter approximately one fourth that of the entire fructification. The spores are very numerous and are about 20μ in diameter.

The description of this specimen, in so far as it can be given with the very limited material at hand, is similar to that given for *Ptychocarpus unitus* Brongn. described from the French Coal Measures (1). *P. unitus* was borne on fern-like fronds of the *Pecopteris* type, and the synangia were arranged on each side of the median vein of the pinnule. Each synangium consisted of six to eight sporangia, arranged as described for the Illinois specimen. The spores were 18-20μ in diameter.

The slightly different fructification described in 1906 by Watson (3), to which he gave the name *Cyathotrachus altus* differed from *P. unitus* in the following ways; the synangium was taller and more slender than *P. unitus,* measuring .5mm. in diameter and about .8 mm. in length; the vascular bundle which traversed the central receptacle in *P. unitus* was not observed in Watson's specimen, the bundle, however, spread out into the cup-like base of short tracheids ending at the base of the sporangia; the spores of *C. altus* were smaller than in *P. unitus,* and were, according to Watson, oval in outline, measuring 12.5μ x 15μ; *C. altus* had a depression in the center extending for about one third the length of the synangium, into which the spores were probably dehisced; while in *P. unitus* dehiscoence probably occurred through terminal pores in each sporangium; the two fructifications were of different geological ages, *C. altus* being of Lower Coal Measure age.

While all of these points cannot be checked in the present material, the geological horizon, dimensions of syrangium and spores, occurrence of vascular tissue in the central receptacle,

which correspond so closely with the description and figures of *Ptychocarpus unitus*, seem to warrant the provisional acceptance of this specimen as identical with it.

1. *Renault, B.*, 1896. Bassin houiller et permien d'Autun et d'Épinac. II: 9.

2. *Scott, D. H.*, 1920. Studies in Fossil Botany I: 3rd. ed; 252. London.

3. *Watson, D. M. S.*, 1906. On a "Fern" Synangium from the Lower Coal Measures of Shore, Lancashire. Jour. Roy. Microscop. Soc. 170: 1.

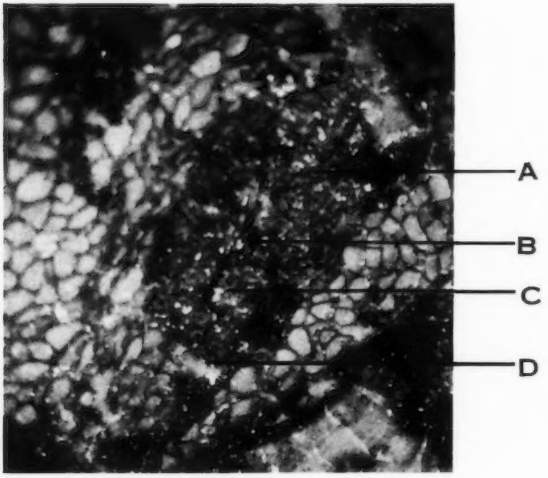

Fig. 1. Transverse (slightly oblique) section of fructification: a, tapetum; b, central receptacle with vascular bundle; c, spores; d, common envelope of synangium. x 65.

UNIVERSITY OF CINCINNATI
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ADVENTIVES IN WESTERN NEW YORK

IRVING W. KNOBLOCH

Recently, several plants were located which subsequent searching of the available records show have not been recorded for western New York.

Polygonum prolificum (Small) Robinson, the proliferous knotweed, can now be listed for Erie county, temporarily at least, having been collected at Tonawanda, N. Y. on July 14, 1930. Normally a plant of the brackish marshes and of the sea shore, this plant has also been found in the middle west and in the New York counties of Wyoming and Onondaga.

Diplotaxis muralis (L.) DC., the sand rocket, is found frequently around waste grounds and ballast heaps at New York city, being an adventive from Europe. It was found at the Buffalo City Hospital in Buffalo, N. Y. on June 12, 1932.

Camelina microcarpa Andrz., the small-fruited false flax, is also a native of Europe and of comparatively recent introduction in this country. Mr. Frank Johnson located it some time ago at Byron. My record was made at the same place and time as was the *Diplotaxis* mentioned above.

Mimulus moschatus Dougl., the musk flower, is a lover of the wet, cool, rocks in the west. It has been reported, in New York state, from Long Island, Saratoga, and other counties but never from Cattaraugus county near Elkdale. It was located here in some numbers on June 21, 1930.

Plantago aristata Michx., the large-bracted plantain, is another rapidly spreading adventive from the west. It is said to be widely distributed in eastern United States because of its aggressiveness. Three plants were found at Buffalo, N. Y. on July 16, 1932.

BOOK REVIEWS

VERTEBRATE PALEONTOLOGY, by Alfred Sherwood Romer. Chicago: University of Chicago Press, 1933. vii + 491 pp., 359 figures. $5.00.

Dr. Romer's volume meets a need that is most urgent among English-speaking students. Treating vertebrates from Agnatha to hominids, *Vertebrate Paleontology* is inclusive; dealing with work appearing even while it was in press, it hardly could be more modern. Simply organized and well written, it may be used with a minimum of effort.

The first chapter is introductory in nature, treating such varied subjects as fossilization, skeletal and muscular systems, and theories of vertebrate origin. Distinction is drawn between vertical, or phyletic, and "horizontal," taxonomic groups, the latter being reserved for those organisms "seemingly ancestral to two distinct families (or lesser groups) or closely related to both." This makes no provision for morphologically equivalent forms of related yet distinct and often noncontemporaneous origins. Such cases are common among invertebrates (the coral *Emmonsia* and the crinoid *Platycrinus*, for instance), and doubtless exist among vertebrates. One would be interested to learn their place in Dr. Romer's philosophy of classification.

Beginning with Chapter II, treatment is taxonomic in order and evolutionary in framework. An introductory survey of anatomy and distribution in time is followed by discussion of groups. In most cases, the evolutionary relationships assumed are those held by the majority of workers, and so demand no special comment. The few exceptions are based on work too recent for general acceptance, but almost certain to receive it. Special interest is given chapters on amphibians, "ruling reptiles" (Archosauria) aand primitive reptiles by the author's own studies in these fields. That on therapsids and pelycosaurs possesses similar advantage, and is specially significant to those concerned with organic response to environments of the land.

Much thought has been given to illustrations. There are many tables of descent and range, with conventional indications of relative abundance. A complete skeleton and skull of a representative of each group treated is shown where possible, with elaboration of details, especially of palate and teeth. Figures have been restored and oriented in order to facilitate comparison; uniformity in sides shown, dentitions selected, and bones pictured in detail greatly aids the student and those who will use the book for reference. Skeletons are reproduced from familiar figures, but most of the skulls have been drawn specially by Mr. L. I. Price, whose work merits special commendation.

A synoptic classification of vertebrates includes families and a number of well-known or important genera, with indication of geolog-

ical and geographical range. The only exceptions are groups, such as teleosts and birds, in which families are very abundant and of small paleontologic interest. A survey of this classification shows the extent to which the book may supplement treatises limited to living vertebrates, or vertebrate groups.

There is a selected bibliography of more than three hundred titles. They are arranged topically, with interspersed notes on the history of vertebrate paleontology. The index consists of fifteen three-column pages; though "mainly taxonomic," it provides for other material.

In fine, *Vertebrate Paleontology* is an able, usable and much needed book, of value for reference in geology, zoology and paleontology, as well as in courses devoted to its special subject.

—CARROLL LANE FENTON

THE LAMARCK MANUSCRIPTS AT HARVARD, edited by William Morton Wheeler and Thomas Barbour. Cambridge: Harvard University Press, 1933. xxxi + 202 pp., $2.50.

This volume presents both the French text and an English translation of six manuscripts by Lamarck in the library of the Museum of Comparative Zoology, five of which were briefly described by Bashford Dean in the *American Naturalist* for 1908 (vol. 42, pp. 145-153). They are:

1. An account of Gall's System (an unpublished lecture) which shows Lamarck's interest in pathology, and some practice of medicine. It does not indicate where he studied, nor the place of delivery.
2. Articles on "idea" and "imagination," published in the *Nouveau Dictionaire d'Histoire Naturelle de Deterville*, 1817; apparently the manuscript from which type was set.
3. An outline of Lamarck's book on human knowledge, a rare work published in 1820.
4. A series of "Questions Zoologiques," written after publication of the *Philosophie Zoologique*, but before 1820—probably during the preparation of the Introduction of the *Historie des Animaux sans Vertebres*, published in 1816. They show some moderation of the extreme positions taken in the former work.
5. A preliminary draft for the fourth chapter of the *Histoire*, sketching the scope and importance of natural history.
6. A brief report of a botanical excursion of June 18, 1797; incomplete and of significance of evolution. It was added to the Harvard collection after publication of Dean's article.

The editorial introduction shows strong sympathy for Lamarck's personality and ideas but the editors do their hero poor service by

quoting Crookshank's paper in *Psyche*, (No. 43, pp. 25-44, 1931) which praises Lamarck for his courage, daring and foolhardiness in assuming the offensive, but condemns Darwin whose life-long illness was a fiction developed "for purely selfish purposes;" who was wilfully unfair, without social feeling—a *calculating* parasite upon a self-sacrificing wife. Skeptical though one may be of natural selection, few will agree that the *Origin of Species* is Darwin's "greatest fiction," and a mere "exteriorization of his neurotic excuses for his own life. . . with all its shifts and evasions." Such condemnation should not be necessary to support the greatness of a man who is all that Wheeler, Barbour and Crookshank believe Lamarck to be, nor does it come gracefully into the present volume. With the associated praise of Lamarck, it does indicate the need for a biography done by some one who cares little for either selection or inheritance of somatic modifications, and who is willing to give even the devil of an offended public its due. For that Lamarck offended scientists, and would offend them today, not even his admirers can deny.—CARROLL LANE FENTON

CONODONT STUDIES NUMBER 1, by E. B. Branson and M. G. Mehl. University of Missouri Studies, vol. 8, No. 1, 1933. 72 pp., 4 plates. $1.25.

This is the first number of a volume to be composed entirely of accounts of the rich conodent assemblages discovered by students and faculty members of the Department of Geology at the University of Missouri. It begins with a survey of conodont relationships and distribution, their value as horizon markers, and methods of preparation and study. In this last connection, it is interesting that the authors recommend whitening by means of ammonium chloride heated and blown upon the specimens—a much simpler method than that which uses liquids.

The studies themselves number three: one of Harding (Middle Ordovician) conodonts of Colorado, one of Bainbridge (Middle Silurian) forms from Missouri, and one of Jefferson City (Lower Ordovician) conodonts of Missouri. The first of these are associated with the remarkable Ordovician fish fauna of Colorado; the last provide diagnostic fossils for a formation heretofore without them in the central region of Missouri. Their presence emphasizes the probable utility of conodonts in correlation.

Descriptions are in part based upon study, by the senior author, of important European types, and are excellently illustrated. Despite the essential artificiality of a classification based on remains which range from crushing teeth to dermal denticles and spines, the value of those remains for geologic purposes seems amply demonstrated. One awaits the three subsequent numbers of the volume with interest.

—CARROLL LANE FENTON

Publications.

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